ResearchGate

See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/339140142

RESTRUCTURING LEARNING MANAGEMENT SYSTEMS FOR MOBILE PHONE USE: A CASE OF MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY. BY

Research · January 2017

CITATIONS
0

READS
124

2 authors, including:



Dickson Kalungi
Mbarara University of Science & Technology (MUST)
2 PUBLICATIONS **0** CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:

RESTRUCTURING LEARNING MANAGEMENT SYSTEMS FOR MOBILE PHONE USE: View project

All content following this page was uploaded by Dickson Kalungi on 10 February 2020.

The user has requested enhancement of the downloaded file.

RESTRUCTURING LEARNING MANAGEMENT SYSTEMS FOR MOBILE PHONE USE: A CASE OF MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY.

BY

Dickson Kalungi
2014/MSIS/137/PS

kaldixo@must.ac.ug
+256-773-554 501

A RESEARCH DISSERTATION SUBMITTED TO THE INSTITUTE OF COMPUTER SCIENCE

FOR THE STUDY LEADING TO A PARTIAL FULFILLMENT OF THE REQUIREMENTS LEADING TO THE AWARD OF MASTER OF SCIENCE IN INFORMATION SYSTEMS OF MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SUPERVISORS:

Dr. RICHARD SSEMBATYA
rsembatya@must.ac.ug
+256-702-398 090

MR. NGOBYE MARTIN
mngobye@must.ac.ug
+256-782-736 246

DEPARTMENT OF COMPUTER SCIENCE
INSTITUTE OF COMPUTER SCIENCE,
MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY

OCTOBER, 2016

Declaration

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of any other degree.

.....

Dickson Kalungi

2014/MSIS/137/PS

kaldixo@must.ac.ug

Approval

The research work culminating to this thesis was conducted under our guidance and supervision..

Signature..... Date.....

Dr. Richard Ssembatya

Institute of Computer Science

Mbarara University of Science and Technology.

Signature..... Date.....

Mr. Ngobye Martin

Institute of Computer Science

Mbarara University of Science and Technology.

Dedication

This work is dedicated to my dear parents and lovely Family

Acknowledgement

First and above all, I am so grateful to the almighty God for the gift of life, providing me the opportunity, grace and granting me the capability to successfully finish this research.

Special thanks to my supervisors Dr. Richard Ssembatya and Martin Ngogye for the guidance , useful comments, remarks, engagement and encouragement throughout this research. May the almighty bless you richly.

I am so much indebted to the Government of Uganda, in particular the ADB-HEST scholarship for the financial support that has enabled me turn my dream of advancing my career into reality.

In a special way, I would like to extend my profound, sincere and heartfelt appreciation to Mr. Kawuma Simon (Dr. to be), my lovely wife Patience as well as my workmates, in particular Mary (Twin), Raymond, Mr. Opio and Beatrice. ***" I will forever die in debt for your kindness, unending love and support".*** I strongly believe that had it not been for your tireless efforts, this success would be a dream out of my reach.

I would be unfair if I do not acknowledge the contribution of all my dear friends, in particular the Master of Science in Information Systems, 2014 pioneers' class for the wonderful collaboration. ***" How I wish the togetherness is maintained forever".***

Lastly but not least, I would like to thank all my research assistants, especially Martin Mukama for the expertise, dedication and assistance that yielded to the success of this research. God bless you abundantly.

Contents

Declaration i

Approval i

Dedication ii

Acknowledgement iii

Acronyms and Abbreviations x

Abstract xi

1 Introduction **1**

1.1 Background to the study 1

1.2 Problem Statement 3

1.3 Objectives 4

1.3.1 General Objective 4

1.3.2 Specific Objectives 4

1.4 Scope of The Study 4

1.4.1 Physical Scope 4

1.5 Significance of the Study 5

2 Literature Review **7**

2.1 Introduction 7

2.2 Terms and Definitions 7

2.2.1 Learning Management System (LMS) 7

2.2.2 Information and Communication Technology (ICT). 8

2.2.3 Electronic Learning (E-Learning) 8

2.3 LMS Adoption rates in Africa 10

2.4 LMS Adoption rates in Uganda 10

2.5 LMS services 12

2.6 Design for Useability 13

2.6.1 User Centered Design 13

2.6.2 Participatory Design 14

2.6.3 Paper Prototyping 15

2.6.4 Design Science in Information Systems 16
2.7 Usability Study about LMS. 17
2.8 User Acceptance Models for Information Systems. 19
2.8.1 Everett M. Rogers' Diffusion of innovations. 19
2.8.2 TAM. 19
2.9 Success factors and barriers of mobile services. 21
2.10 LMS design and implementation.(Research Gap). 22

3 Methodology **24**
3.1 Introduction 24
3.2 Design Science in Information Systems Research. 24
3.2.1 Environment 25
3.2.2 Design science research cycle 26
3.2.3 Knowledge base. 26
3.3 User-Centered Design (UCD). 26
3.3.1 User-Centered Design (UCD) Processes. 27
3.3.2 Step 1:Plan the human centered process. 27
3.3.3 Step 2: Specify the Context of use. 28
3.3.4 Step 3: Specify user and organizational requirements. 28
3.3.5 Step 4: Produce design solution. 28
3.3.6 Step 5: Evaluate design against user requirements. 28
3.4 Instruments and Ethical considerations 28

4 Presentation of Results and Discussions. **30**
4.1 Introduction 30
4.2 Research Perspective 30
4.3 Requirement Analysis, Fact-finding and Conceptualisation 31
4.4 Data Analysis 31
4.4.1 Results from the preliminary study 31
4.5 Results for Objective 1 35
4.5.1 LMS services 35
4.6 Results for Objective 2 40
4.6.1 Participatory Design 40
4.6.2 LMS Mobile App Design 40

4.6.3 Evaluation of the Paper Prototypes 42
4.7 Results for Objective 3 45
4.7.1 Moving from design to development 45
4.7.2 Screen Elements of the Mobile phone based LMS. 45
4.8 Results for Objective 4 47
4.8.1 Results from the Claroline LMS before mobile LMS 47
4.8.2 Results from the mobile phone based LMS 48
4.8.3 Comparison between the two LMSs 49
4.8.4 Average usage between the two LMS systems 49

5 Conclusion and recommendations. 50
5.1 Conclusion 50
5.2 Recommendations 51
5.3 Limitations 51
5.4 Future Work 52

Appendices 60
A Questionnaire 62
B Research Ethics committee Approval 66
C Screen Elements for Announcements 67

List of Tables

2.1 LMS Services. Source: (Ssekakubo [69] and (www.moodle.org) and Sakai (www.sakaiproject.org)) 12

3.1 Sample Size of Participants involved in the study 25

4.1 Reasons for not using the LMS 33

List of Figures

2.1 TAM (Adopted: (Davis1989) 21

3.1 Design science research cycles (Adopted: (Hevner 2007) 24
3.2 User Centered Design) 27

4.1 Type of Phone owned 31
4.2 Knowledge about LMS 32
4.3 LMS usage 32
4.4 Preferred Device to access the LMS 34
4.5 Preference to using a mobile phone to access LMS services 35
4.6 Course Outline 36
4.7 Downloads 37
4.8 Announcements 37
4.9 SMS Alerts 38
4.10 Assignments 39
4.11 Chatting 39
4.12 Participatory Design Workshop sessions 41
4.13 Hand drawn paper prototype 1 42
4.14 Hand drawn paper prototype 2 43
4.15 Paper Prototype 44
4.16 Login Screen 45
4.17 Course Navigation 45
4.18 Course Menu 45
4.19 Menu Items 46
4.20 Download page 46
4.21 Download Status 46
4.22 LMS folder 47
4.23 Sub folders 47
4.24 Claroline LMS statistics for the month of August,September and October . . 47
4.25 Mobile Phone based statistics for the month of August, September and October 48

4.26 Comparison between Claroline LMS and the Phone based LMSs 49
4.27 Monthly Average usage between the two LMSs 49

List of Acronyms

BBA: Bachelor of Business Administration

BCE: Bachelor of Science in Computer Engineering

BIT: Bachelor of Information Technology

CEMAS: Computerised Education Management and Accounting System

FOM: Faculty of Medicine

FOS: Faculty of Science

ICS: Institute of Computer Science

ICT: Information and Communication Technology

IITR: Institute of Interdisciplinary Training and Research

IMS: Institute of Management Science

LMS: Learning Management System

MUST: Mbarara University of Science and Technology

MBR: Bachelor of Medicine and Bachelor of Surgery

Abstract

As universities in Uganda strive to satisfy their students' needs, they are facing various challenges ranging from educational to economic challenges. Some challenges require that universities have to adopt to new mechanisms of interacting with their students. ICT has proved to be an essential component of the education system by bridging the gap between students and Lecturers. The application of ICT to enhance teaching and learning is commonly referred to as E-learning. Learning Management Systems are among the ICT tools that can be used to implement e-learning in high institutions of learning. The success of LMSs in high institutions of learning is mainly attributed to Internet penetration as well as a well-developed ICT infrastructure. However, the adoption rates for LMSs are still very low in Sub-Saharan countries, in particular Uganda and MUST due to Poor internet facilities, lack of personal computers by students to access the LMS, Lack of user involvement during the initial design process of LMSs, Weak and unimplemented ICT policies regarding LMS usage, Unstable power among other hindrances.

In this research, we carried out a survey to investigate the percentage of students who own smart phones and would prefer to use their phones to access selected LMS services that are more needed by users at MUST. It was interesting to note that that 75% of the participants owned smart phones and / Tablets and 62.5% preferred to use their mobile phones to access LMS services compared to 19.5% who preferred to use their Personal computers. This implies that mobile phones can successfully be used as an alternative way for accessing the LMS.

Course outline, Assignments, Download, Announcements, chats and SMS alerts were proved to be the most required services by users at MUST.

User centered design, participatory design and paper prototyping were successfully used during the design process. Results obtained from the deployment of the mobile phone based LMS indicated that there was an increase in the LMS usage. This increase in usage was mainly attributed to the perceived ease of use, perceived usefulness and users' intention to use the system since users had been involved in the initial design of the system which made them accountable to the final system.

Chapter 1: Introduction

1.1 Background to the study

As universities in Uganda strive to satisfy their students´ needs, they are facing various challenges ranging from educational to economic challenges. Some challenges require that universities have to adopt to new mechanisms of interacting with their students. Information and communication technology (ICT) has proved to be an essential component of the educational system. It has positively impacted the educational system and has played an important role in meeting both educational and economic challenges by bridging the gap between lecturers and students.

The application of ICT to enhance teaching and learning is commonly referred to as Electronic Learning(E-learning). E-learning is involves using computer devices to deliver part, or all of the course. Learning Management Systems (LMSs) are among the ICT tools that can be used to implement E-learning in high institutions of learning. The success of LMSs in high institutions of learning is attributed to internet penetration as well as a well-developed ICT infrastructure.

A Learning Management System (LMS) automates the administration of training events. All Learning Management Systems manage the log-in of registered users, manage course catalogs, record data from learners, and provide reports to management [24]. LMSs enable faculty members to upload learning resources for learners to access via the Internet. They also provide interaction between learners either synchronously or asynchronously via communications tools. The communication tools include email, chat, whiteboard and discussion forums. Institutions tend to use these systems to supplement traditional face-to-face delivery by enabling learners to access learning resources through electronic means [73]. LMSs are also used to enhance existing distance courses and therefore reaching more learners across various geographical boundaries [9].

The adoption and use of various LMSs to complement traditional face-to-face classroom

sessions and to widen access to education through distance learning in Africa is becoming common [58]. A survey by Ssekakubo [69] in five African Universities demonstrated that they had installed several LMSs. In a related study, Mtebe & Raisamo [57] conducted a survey in 11 institutions in Tanzania, and half of these institutions had installed LMSs. Hoosen & Butcher [34] further demonstrated that seven institutions that participated in Partnership of Higher Education Africa (PHEA) project were found to have installed various LMSs. Similar results were obtained from surveyed institutions in Kenya [73], Uganda [54], Sudan [26], and Zimbabwe [18]. These adoption rates have greatly been attributed to the growth of information and communication technologies (ICT) which has dramatically reshaped teaching and learning processes in higher education [81], [5].

ICT for education is more critical today than ever before since its growing power and capabilities are triggering a change in the learning environments available for education [61]. The use of ICT offers powerful learning environments and can transform the learning and teaching process so that students can deal with knowledge in an active, self-directed and constructive way [74], [23].

In Uganda however, the potential of LMSs has not been fully exploited by higher institutions of learning due to lack of stable and fast internet, unstable power, lack of enough computers to accommodate all students, failure to involve users in the initial LMS design as well as implementing open source LMSs that do not match the user requirements for higher institutions of learning in the Ugandan setting. A combination of these factors have negatively affected the acceptability and usability of LMSs. Mc Gee et al., [55] also indicated that LMS in African Universities are largely lacking in effective instructional functions.

Mbarara University of Science and Technology has grown both in numbers of students and Faculties / Institutes. Currently, the university has three faculties that is, Faculty of Medicine (FOM), Faculty of Science(FOS) and Faculty of Applied Science and Technology (FAST), and Five institutes. That is:-Institute of Computer Science (ICS), Institute of Management Science (IMS), Institute of Inter Disciplinary Training and Research (IITR), Institute of Tropical Forest Conservation (ITFC) and The Institute of Maternal Newborn and Child Health. The current students´ population is over 3000. It is therefore against this background that the adoption of modern technology to support the learning activities

has been inevitable. One of the modern technologies being adopted is the installation of Claroline learning management system which is a software application used to integrate technological and pedagogical features into a well-developed virtual learning environment [72]. In addition, LMSs enable instructors to create and support dynamic learning environments [40].

With all the benefits of LMSs, the adoption rates at MUST are still very low and this is mainly attributed to a number of factors like, limited network infrastructure,limited computers which is evidenced by the ratio of one computer to twelve students (1:12, with only four computer laboratories which also serve as classrooms, unstable power among others.

1.2 Problem Statement

Despite increased adoption of various LMSs in higher institutions of learning, the actual usage is low across the African continent [69]. Studies conducted by Mayoka & Kyeyune in 2012 [54] indicated that there were only 60 users using the LMS installed at Makerere University in Uganda, and less than 10 users at the University of Nairobi in Kenya [69]. Recent studies by Mtebe [57], demonstrated that there were only 103 users at University of Dodoma, 767 users at the University of Dar es Salaam, 81 users at Open University of Tanzania, and 49 users at the Institute of Finance Management, in Tanzania. The situation is similar in several institutions in Zambia, Zimbabwe, Mozambique, and Sudan [25].

From the analysis of LMS logs at MUST, it was established that the LMS usage was very low. This low usage was mainly attributed to limited infrastructure, unstable power, lack of enough computers, ever congested computer labs and poor user interface design. Findings from preliminary studies demonstrates that over 70% of MUST students possess mobile phones and would prefer to access LMS services via their mobile phones, which presents an opportunity to explore alternative ways of making LMS services effectively available to the students via their mobile devices.
Mtebe [57] demonstrates that clearly developed mobile phone-based LMS interfaces will inspire students and lecturers to use their mobile devices to access LMS service, hence it is against this background that we proposed an innovation for Re-structuring the LMS at MUST for mobile device use.

1.3 Objectives

1.3.1 General Objective

The general objective of the study was to investigate the mobile phone-based LMS intervention to enhance accessibility of Learning Management System (LMS) services at MUST. The Intervention required restructuring MUST Learning Management System for Mobile phone Use. The study involved the design, implementation and evaluation of mobile phone-based LMS for accessing selected LMS services.

1.3.2 Specific Objectives

1. To explore the LMS services that are more needed and required by users at MUST.
2. To design a mobile phone-based LMS with selected services that will enable users access LMS services at their convenience.
3. To develop a a mobile phone based LMS for selected services.
4. To evaluate whether there is an increase in accessibility and usage of LMS services.

1.4 Scope of The Study

1.4.1 Physical Scope

The scope of the research was limited to all Faculties and Institutes of Mbarara University of Science and Technology targeting all users and beneficiaries of the LMS. MUST was established as an act of the Parliament of Uganda by the MUST statute of 1989 as the second public University in an effort to re-address the imbalance in availability of social services, including schools and health services that tended to favor urban areas and excluded the rural areas where most of the population lives. The University is situated in southwestern Uganda in Mbarara municipality about 286 kilometers from Kampala and about 2km from Mbarara town along Mbarara-Kabale high way. The establishment of MUST was geared towards copying up with the increasing demand for trained and skilled personnel in science and technology. Since its inauguration, the university has passed out 11,236 students of which 5,814 are males and 5,422 are females, graduating in various disciplines including Medicine and Surgery (MBChB), Science Education (BSc Ed), Pharmacy (PHA), Nursing (BNS/BNC), Medical Laboratory Science (MLS/MLC), Information Technology (BIT),

Computer Science (BCS), Computer Engineering (BCE), Development Studies (BDS) and Business Administration (BBA). The University has also graduated several postgraduate students in different disciplines both at Masters and PhD level.

The study involved designing a mobile based LMS for selected services that were found out to be more needed and required by users at MUST. Users were involved in the design process using participatory design approach. The system was deployed to the users to evaluate whether it met the users' expectations.

1.5 Significance of the Study

Mobile based LMS will offer better accessibility for both learners and lecturers. Learners will be able to learn at their convenience anywhere and anytime, rather than relying solely upon computers in the computer laboratories which also serve as lecture rooms and are always congested. Students can use their smart phones / tablets to access courses and Mobile based LMS will offer better accessibility for both learners and lecturers' information. On the other hand, lecturers can utilize their tablets, mobile phones, and any other internet-based device to upload content and communicate with other collaborators and learners.

Using the LMS as the central platform for managing learning across multi-department, geographically dispersed faculties/ Institutes, (Kihumuro, Mulago center, Jinja Center), training will no longer be dominated and hindered by time restrictions and will become a continuous process, available when needed by the learners. This offers a wide range of flexibility especially for the learners. Apart from attending face-to-face training session or participating in a live group discussion, learners can continue acquiring and exchanging additional knowledge over the LMS through social learning and knowledge collaboration features like the chatting system incorporated in the LMS.

Mobile based LMS will also reduce dependency. Missing face-to-face learning session due to unavoidable reasons will not mean loss of crucial information for learners while using a mobile based LMS for managing learning activities. Students will be able to access learning resources via a LMS. Thus, learners are not completely dependent on one source of information, but can access it from the LMS whenever they need it. This also encourages self-paced learning amongst the learners and increases knowledge retention as it is acquired

at their own level of comfort. Students will also get flexible access to training materials. Distributing training resources though an LMS allows learners to access resources whenever they need it during training. It will also be convenient for learners in different locations, allowing everyone access to the same training materials at any time.

Mobile based LMS will also provide students with an opportunity to join the social learning trend of learning. This can be achieved through building an online community and encourage interaction amongest learners to share content on social media sites like Facebook, Twitter and LinkedIn.

Students will benefit from Phone based reminders and organizers which will be integrated with the LMS platform. Learners will get ongoing notifications and updates on their courses, which will enable them check anywhere and anytime. Students will also be able to resume their course easily, without unlearning previous content.

The study will also contribute to knowledge especially for researchers who are interested in LMSs. The findings of the study will be documented and published for access to the public and facts from the study will be used for academic purposes.

The study is also a requirement for the fulfilment of the requirements for attaining a Master of Science in Information Systems at MUST.

Chapter 2: Literature Review

2.1 Introduction

This chapter reviews what other academicians, scholars and researchers have documented about the LMSs, so as to establish facts to support the need for restructuring the MUST LMS for mobile phone use. This chapter shows extensive reference to related research and theory in the field. It is where connections are made between the source texts that the researcher will draw on and where he will position himself amongst these sources.

2.2 Terms and Definitions

2.2.1 Learning Management System (LMS)

LMS is a Web-based systems that allows instructors and students to share instructional materials, make class announcements, submit and return course assignments, and communicate with each other online using an integrated set of web-based tools for learning and course management.

Further more, LMSs are web based systems used to plan, deliver and facilitate students learning via the internet [73]. They are normally integrated with learning resource tools for audio, video, and text as well as commutation tools such as (chat, discussions forums, email, whiteboards) and assessment tools [63].

According to Lonn [48], a LMS is a type of software designed to deliver, track, and manage training and education. Through their development, these systems have been called Course Management Systems (CMS), Virtual Learning Environments, Collaborative Learning Environments, and a host of other monikers. The software is similar in functionality, despite its name, and typically includes methods to manage users, role, and course information, online communication, grading, and web-based or blended delivery of content.

2.2.2 Information and Communication Technology (ICT).

The term ICT as applied to education refers to technologies such as computers, the Internet, broadcasting technologies (radio and television), and telephony that can facilitate not only the delivery of instruction, but also learning processes itself. These technologies have been identified as important tools for realizing a new paradigm of learner-centered education that better supports learners' needs through differentiated and personalized instruction [77].

The International Society for Technology in Education (ISTE) emphasizes that teachers of today should prepare to provide technology-based learning opportunities for their students [32]. ICT use has increased dramatically over the last few years. In the developed regions, the percentage remains much higher than in the developing world (MDG Report 2010).

On the other hand, adoption and usage of ICT is not restricted to developed countries only, Several developing countries have also adopted technology in their educational systems [35]. For instance, in 2007, the Minister of Higher Education in Lebanon announced the distribution of 400 computers for public schools, connected to the Web through broadband [59].In Kenya, Wims and Lawler [78] examined the impact of ICT projects in educational institutions, and found substantial benefits to students.

2.2.3 Electronic Learning (E-Learning)

E-learning is the use of computer and Internet technologies to deliver a broad array of solutions to enable learning and improve performance.

There are two general approaches to e-learning: self-paced and facilitated/instructor-led. Self-paced learners are alone and completely independent, while facilitated and instructor-led e-learning courses provide different levels of support from tutors and instructors to collaboration among learners.

In Self-paced e-learning, learners are offered e-learning courseware (also called Web-based training (WBT)), which can be complemented by supplemental resources and assessments. Courseware is usually housed on a Web server, and learners can access it from an online learning platform or on CD-ROM. Learners are free to learn at their own pace and to define

personal learning paths based on their individual needs and interests. [27]

E-learning providers do not have to schedule, manage or track learners through a process. E-learning content is developed according to a set of learning objectives and is delivered using different media elements, such as text, graphics, audio and video. It must provide as much learning support as possible (through explanations, examples, interactivity, feedback, glossaries, etc.), in order to make learners self-sufficient. However, some kind of support, such as e-mail-based technical support or e-tutoring is normally offered to learners. When self-paced e-learning is offered through an Internet connection, there is the potential to track learners' actions in a central database. [27]

Instructor-led and facilitated e-learning on the other hand, a linear curriculum is developed that integrates several content elements and activities into a chronological course or syllabus. The course is scheduled and led by an instructor and/ or facilitator through an online learning platform. E-learning content for individual study can be integrated with instructors lectures, individual assignments and collaborative activities among learners. Learners, facilitators and instructors can use communication tools such as e-mails, discussion forums, chats, polls, whiteboards, application sharing, audio and video conferencing to communicate and work together. At the end, a final step typically includes an exercise or assessment to measure learning. [27]

E-Learning can be asynchronous (meaning learners are experiencing the learning at different times) or synchronous (meaning learners are experiencing the learning at the same time) or it can incorporate both drawing on the strengths of each. Independent learning is, by definition, asynchronous. Facilitated and collaborative can be either asynchronous or synchronous. [27]

Often E-learning and LMS are always confused. However, it should be clearly noted that the two are different. LMS is a tool that can be used to implement E-learning. Hence this study focus was on LMS and not E-learning.

2.3 LMS Adoption rates in Africa

The adoption of LMSs by higher education institutions in sub-Saharan Africa has continued to increase. Adkins [3] predicts LMS adoption will grow at the rate of 15% per annum between 2011 and 2016 in the region. As of 2010 almost 52% of the 358 respondents from 25 African countries indicated that they were using a LMS [73].

Research conducted within the sub-Saharan Africa region has documented these LMS adoption patterns. Ssekakubo et al, [69] found that 5 of the surveyed institutions in sub-Saharan Africa had installed a LMS, mostly Moodle and Sakai. A study conducted by Lwoga [73] found that all the 6 surveyed institutions in Tanzania had adopted Moodle LMS. Similarly, Author and co-author [49] found half of the 11 surveyed institutions had installed Moodle LMS while Munguatosha, Muyinda, and Lubega [19], found that 80% of surveyed institutions in Tanzania were using Moodle LMS. Moreover, the 7 institutions that participated in the Partnership for Higher Education in Africa (PHEA) project were found to have installed various LMS of several types [34]. Studies have also shown that several institutions have installed various LMS in countries such as Kenya [73], Sudan [26], and Zimbabwe [18].

The most popular systems deployed in several institutions in Sub-Saharan countries are: Blackboard, Moodle, Atutor, Sakai, and Kewl [69], [73]. These systems are believed to be able to leverage the challenges facing the education sector in Sub-Saharan countries.

With the ever growing ICT facilities in Africa, it is believed that proper application of LMSs have the potential to widen access, reduce cost, and improve the quality of education [63], [48]. These perceived benefits have heightened Higher Education Institutions (HEIs) in Sub-Saharan countries to adopt several ICTs in order to complement the traditional face-to-face delivery of learning material and introduce technology enhanced learning like LMSs. So far, several systems have been adopted in various HEIs in Sub-Saharan countries every year.

2.4 LMS Adoption rates in Uganda

According to Mayoka & Kyeyune [54], The introduction of UPE and UCE developments led to a surging increase in the number of students enrolling to study hence putting pressure on

the available infrastructure [42]. This pressure is currently being felt in higher institutions of learning where there is limited space and other resources such as facilitators (MoES 2009). Ugandans remained illiterate with literacy rates standing at only 65% [4]. The government of Uganda is now encouraging alternative means of meeting the demand particularly of higher education, one of these being e-learning, especially in higher institutions of learning. Subsequently, universities have tried to develop and implement LMSs a way of supporting the Government's initiative.

Makerere University, the biggest and oldest university in the country was the first to start e-learning using the Blackboard platform. They have since moved to a new system called Makerere University Electronic Learning Environment (MUELE) based on a Moodle platform. Other universities such as Nkozi and Makerere University Business School and other universities have also followed suit [54]. The advent of e-learning at Makerere University Business School was pioneered by Nettel Africa, a conglomerate of universities promoting ICT usage and policy on the African continent. Nettel Africa introduced the Knowledge Environment for Web-based Learning (KEWL) system, which targeted students pursuing a postgraduate programme in ICT Policy and regulation. The system has most of the e-learning requirements with a lot of course content, materials and online discussion forums. The introduction of the KEWL system excited and attracted quite a good number of students initially until recently when MUBS failed to enroll students on the programme in the academic year 2010/2012.

In the early 2010, the International Center for Information Technology and Development (ICITD) introduced another e-learning system that runs a Moodle platform but the system has failed to pickup to date. For example, since its inception in 2010, the eMUBS system has registered only about 60 users. This number is less than 10% of the Makerere University Business School and other universities community. Worse still is that the 60 registered users are not active. Virtually no activity takes place on the system despite huge maintenance costs being incurred to keep the system running. Out of the 3 Ugandan universities that have attempted using e-learning, it is only Makerere University that has registered considerable success. However, this achievement is only at postgraduate level as most undergraduate students use classrooms and other traditional teaching methods only [54].

In 2013, MUST joined the trend by installing Cralorine LMS. This was an open source software that was expected to be used by the entire University. However, not different from other Ugandan Universities like Makerere and MUBS, the system is not being used as expected evidenced by low usage in the system logs that indicate an average of less than 10% per year.

2.5 LMS services

LMSs offer a wide range of services. Their ability to utilize web technologies and internet services to support education has broadened the scope of these services to range from online course creation, maintenance and delivery; student enrolment and management; and education administration and student performance reporting [31], [21].

Table 2.1 shows a list of the most common LMS services that are believed to be useful to learners.

Announcements	For viewing current, time critical information
Assignments	For viewing, posting and submitting assignments
Blogs	For course or project blogging or journals
Chat room	For real-time conversations in written form
Course outline	For summary outline and/or course requirements
Drop box	For private file sharing between instructor and student
Forums	Displaying forums and topics of the course
Maps	For using interactive Google Maps
Messages	Displaying messages to/from course participants
News	For displaying news and updates from online sources (RSS feeds)
Participants	For viewing course participant list
Resources	For accessing documents, URLs or other web sites
Wiki	For collaborative editing of pages and content
Tests and quizzes	For taking online tests/quizzes
Slideshow	For showing and viewing slideshows of image collections from resources

Table 2.1: LMS Services. Source: (Ssekakubo [69] and (www.moodle.org) and Sakai (www.sakaiproject.org))

LMSs also allow learners to use interactive features such as threaded discussions, chat rooms, discussion fora, and other methods of communication. A typical LMS, such as Sakai or Moo-

dle, may have as many as 20 or more service components [70].

Since LMSs have several service components as indicated in table 2.1, and some of which are occasionally accessed by students, or at times never accessed at all, the most feasible and appropriate way to optimize the LMS for mobile access would therefore be to provide a few selected services, with the necessary detail for each service [70]. It is anticipated that having fewer but most important services for LMS will increase the usability and acceptance of the system.

2.6 Design for Useability

2.6.1 User Centered Design

According to Abras, et al., [2], the term user-centered design is believed to have originated from Donald Norman's research laboratory at then University of California San Diego (UCSD) in the 1980s and became widely used after the publication of a co-authored book entitled: ***User-Centered System Design: New Perspectives on Human-Computer Interaction***. Norman built further on the UCD concept in his seminal book ***The Psychology Of Everyday Things (POET)***. Norman recognizes the needs and the interests of the user and focuses on the usability of the design. He offers four basic suggestions on how a design should be:

1. Make it easy to determine what actions are possible at any moment.
2. Make things visible, including the conceptual model of the system, the alternative actions, and the results of actions.
3. Make it easy to evaluate the current state of the system.
4. Follow natural mappings between intentions and the required actions; between actions and the resulting effect; and between the information that is visible and the interpretation of the system state. [2]

These recommendations place the user at the center of the design. The role of the designer is to facilitate the task for the user and to make sure that the user is able to make use of the product as intended and with a minimum effort to learn how to use it.

The involvement of users assures that the product will be suitable for its intended purpose in the environment in which it will be used leading to the development of products that are more effective, efficient, and safe. This is because when users are involved in the design, deeper understanding of the psychological, organizational, social and ergonomic factors that affect the use of computer technology emerges from the involvement of the users at every stage of the design and evaluation of the product.

User involvement also helps designers manage the expectations of the user about the intended product. When users have been involved in the design of a product, they know from an early stage what to expect from a product and they feel that their ideas and suggestions have been taken into account during the process. This leads to a sense of ownership for the final product that often results in higher customer satisfaction and smoother integration of the product into the environment [2].

2.6.2 Participatory Design

Participatory design aims at including users in the design process so that users voice is reflected in the design of a technology they use. [14] Through participatory design, the end users are involved in the design of a new artifact as they are more aware of what the designs should contain. Participatory design was adopted from the the Scandinavian work tradition, whereby workers were delegated managerial tasks.

The core method of participatory design includes workshops and design sessions in which users are encouraged to think creatively and propose their own ideas. Ethnography is also used in conjunction with participatory design to gain a deeper understanding of users. Beyond workshops, ongoing activities in which designers prepare prototypes and mockups and obtain feedback from users in a continuous manner are also crucial. To assist users who are not familiar with design practices, cards are often used as a medium of gathering and structuring data. In a more proactive approach, users are given design tools by which they can explore designs on their own. [37]

Participatory design has proved to be very important because it encourages designers to look at things from another's point of view. In addition, it also helps designers gather several other facts about certain design situations they may not have been aware of hence making

the design more complete which will in turn increase the useability and acceptability of the system.

2.6.3 Paper Prototyping

Paper prototyping is a group creativity technique developed to generate different ideas when designing, creating, testing and communicating any type of user interfaces (UIs).The resulting UIs are, later on, used for the selection of an appropriate solution. Examples of such UIs are software programs, applications from mobile devices and websites.

The mechanism of paper prototyping starts with a meeting from all the members of the product team to choose the type of user who represents the target audience for the UI. Afterwards, a usage profile is created. Usage profile is a set of typical tasks describing uses for the system. The next step is to make screen shots and/or hand sketched versions of all the components from the UI required for the usage profile.

Advantages of Paper Prototyping

Though there are many techniques for exploring user interfaces in the early stages of design, like the use of high-fidelity tools, informal design tools, and Wizard of Oz studies, paper prototyping is preferred mainly dues to the following reasons.

Paper Prototyping provides substantive user feedback early in the development process. This helps the designer and developer to adjust accordingly before investing a lot of efforts and resources in implementation.

Paper Prototyping technique also promotes rapid iterative development. The designer can experiment with many ideas rather than having to rely on one which might be lacking some important components required by users.

There are different methods of paper prototyping, each of them showing several benefits regarding the communication within the development team and the quality of the product to be developed: In the development team paper prototypes can serve as a visual specification of the graphical user interface, and by this means assure the quality of a software. Prototyping forces a more complete design of the user interface to be captured. In team meetings they provide a communication base between the team members. Testing prototypes at an

early stage in development helps to identify software usability problems even before any code is written. The costs and annoyances of later changes are reduced, the support burden is lowered, and the overall quality of the software or website is increased. [11]

Technical skills are not required during Paper Prototyping. Therefore, a multidisciplinary team can work together which encourages creativity in the product development process

In conclusion therefore, it is against this background that paper based prototyping was seen as the best choice in designing the mobile based LMS mainly because of its strong attachment to users' needs and user centered design.

2.6.4 Design Science in Information Systems

Hevner [75] argues that knowledge that aids in the productive application of information technology to human organizations and their management involves two complementary but distinct paradigms, behavioral science and design science [51]. The behavioral-science paradigm has its roots in natural science research methods (Simon 1996). It seeks to develop and justify theories (i.e, principles and laws) that explain or predict organizational and human phenomena surrounding the analysis, design, implementation, management, and use of information systems. Such theories ultimately inform researchers and practitioners of the interactions among people, technology, and organizations that must be managed if an information system is to achieve its stated purpose, namely improving the effectiveness and efficiency of an organization [75].

The significance of design is well documented in the IS literature [79]. Benbasat [13] contend that the relevance of IS research is directly related to its applicability in design, affirming that the implications of empirical IS research should be implementable, Synthesize an existing body of research, or inspire critical thinking among IS experts. However, designing useful artifacts is complex due to the need for creative advances in domain areas in which existing theory is often insufficient. As technical knowledge grows, IT is applied to new application areas that were not previously believed to be acquiescent to IT support [52]. The resultant IT artifacts extend the boundaries of human problem solving and organizational capabilities by providing intellectual as well as computational tools. Theories regarding their application and impact will follow their development and use. Von [75], contend that an opportunity

for IS research is to make significant contributions by engaging the complementary research cycle between design science and behavioral-science so as to address fundamental problems faced in the productive application of information technology. Technology and behavior are not dichotomous in an information system. They are inseparable [46]. They are similarly inseparable in IS research. Philosophically these arguments draw from the pragmatists [1] who argue that truth (justified theory) and utility (artifacts that are effective) are two sides of the same coin and that scientific research should be evaluated in light of its practical implications.

Design science, as the other side of the IS research cycle, creates and evaluates IT artifacts intended to solve identified organizational problems. Such artifacts are represented in a structured form that may vary from software, formal logic, and rigorous mathematics to informal natural language descriptions [75].

2.7 Usability Study about LMS.

ISO 9241 defines Usability as the effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments. Effectiveness is the accuracy and completeness with which specified users can achieve specified goals in particular environments. Efficiency is the resources expended in relation to the accuracy and completeness of goals achieved and Satisfaction is the comfort and acceptability of the work system to its users and other people affected by its use.

According to Costabile, [20], Ardito et al [10] and Wong et al [80], usability plays a significant role towards the success of e-learning applications if an e-learning system is not usable enough, it obstructs students learning: the learners would spend more time learning how to use the system rather than learning the content. This further explains why it is very important not to have several services that will never be utilized by students which may end up confusing them hence rejecting the use of the system.
Usability is one of the very important feature of a system as it has direct impact on how users use the system. Given the majority of institutions have been adopting LMS without conducting usability evaluations, it is apparently not clear whether these systems are usable to learners in African institutions [69]. Many institutions have been adopting open source LMS due to lack of funds to pay for license fees for commercial systems. Nevertheless, the

majority of open source systems suffer from usability problems [60]. For example, Martin et al., [53] found that none of LMS reached 80% of compliance of usability heuristics in a study conducted to compare usability of Moodle, Sakai, and dotLRN.

Previous studies Paulo [45] and Dagger et al, [71] oppose that, despite the success in the promotion of the standardization of e-learning systems, usability and accessibility are still a major user concern with the existing systems. According to the previous research [45], and [21] also revealed that adapting service oriented architectures (SOA) to e-learning systems so as to provide flexible learning environments for learners could improve the usability and accessibility of the services. Dagger [21] also argues that the current generation of LMSs embraced a significant development; the services principle, exposing certain aspects of their functionality externally. This means that, as designs became more modularized, it is easier for platforms to integrate new functionality as it arises [70]. Furthermore, the LMS community has made an increased move towards separating content from tools, and the learner information has become more distinguished. However, these systems arent entirely learner-centric; they still focus strongly on learning administration (course management) rather than on the learner [21]. Change is difficult but it is probable that the rapid development and implementation of new technologies and social changes make change in the educational provision inevitable [36]. Nowadays, most of the universities are struggling to enhance the professional experience and skills of their personnel in order to utilize the new Technologies in their teaching activities in an efficient way [16].

New technologies allow students to learn more in less time and allow universities to focus on global learning environments if used appropriately [8]. Also, modern technologies have made learning possible at any time and place. On the other hand, in connection with the possibilities offered by modern technology (i.e. evolution of mobile devices) pose new opportunities and new challenges to the educational systems [44]. Using wireless transmission and mobile devices such as PDAs, mobile phones, laptops and tablet PCs is defined M-learning [66]. This new learning environment supports collaborative and accessible learning experiences for both instructors and students that are integrated anytime and anywhere beyond the classroom. According to Wagner [76], mobile learning allows instructors to utilize the strengths of mobile platforms to bring a variety of new applications to the learning environment [12], [41], [43], [82] such as mobility, ease of movement and use, flexibility, functionality, con-

venience, simplicity, speed, affordability, economic/cost benefits, information management capacity, and share information instantly. [16].

2.8 User Acceptance Models for Information Systems.

2.8.1 Everett M. Rogers' Diffusion of innovations.

Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. Diffusion is a special type of communication concerned with the spread of messages that are perceived as new. (Rogers, 2003). Rogers describes an innovation as any idea, practice or object that is perceived as new by an individual or other unit of adoption. An innovation in this sense therefore also implies new knowledge and new knowledge products. The four main elements in the diffusion of new ideas are, the innovation, Communication channels, Time and The social system (context).

2.8.2 TAM.

The Technology Acceptance Model (TAM) was introduced by Fred D. Davies in 1985 and is a model for evaluating user acceptance in information systems. According to Davis,the goal of TAM was to provide a theory for developers to successfully design and implement information systems as to give developers a model for evaluating planned information systems before implementing them.TAM has proven to be a theoretical model in helping to explain and predict user behavior of information technology [47]. TAM is considered an influential extension of the theory of reasoned action (TRA). Davis [22] proposed TAM to explain why a user accepts or rejects information technology by adapting TRA. [6]. TAM provides a basis with which one traces how external variables influence belief, attitude, and intention to use. Two cognitive beliefs are posited by TAM: Perceived usefulness defined as "the degree to which a person believes that using a particular system would enhance his or hers job performance" and Perceived ease of use which is defined as "the degree to which a person believes that using a particular system will be free of effort". However, both of these determinants are influenced by several external variables. For example, perceived ease of use can be affected training and documentation [22]. If an information system is well documented it will be easier for a user to start using it. The same applies for training. If MUST is restructuring its LMS for mobile phone use,it should have good training routines, to make it easier for the users to learn the system and accept the new technology. Emerging information technology cannot deliver improved organizational effectiveness if it is not ac-

cepted and used by potential users. Technology Acceptance Model (TAM) is one of the most successful measurements for computer usage effectively among practitioners and academics. TAM is consistent with Everett Rogers (1983) theory on diffusion of innovation where technology adoption is a function of a variety of factors including and Relative advantage Ease of use. According to Davis [22], Investments in computer-based tools to support planning, decision making and communication processes are usually risky. Recognizing the difficulty of specifying the right systems requirements based on their own preferences and logic, systems builders always seek methods for evaluating the acceptability of systems as early as possible and also need to know why people resist computers predicting how users will respond? And attempt to improve users response. Davis's original TAM predicts acceptance based on the end-user's perceived usefulness (PU) and perceived ease of use (PEOU) of the technology for a specific purpose.

Perceived usefulness and perceived ease of use contribute in the creation of an attitude towards using technology. The connection between perceived ease of use and perceived usefulness indicates that perceived usefulness will be affected by the level of user-friendliness in the information system. If the system has high user-friendliness, this will most likely increase the level of satisfaction for the user, and make the system more useful. Even though perceived ease of use directly affects the attitude towards using the technology, it has no direct effect on the intention to use the technology. Perceived ease of use does not determine whether you will use a new information system or not, but will rather create an attitude towards using it. If an information system has high user-friendliness it will have a positive impact on the user and create a positive attitude towards using the new technology. If a new information system has no real usefulness for the user in doing his job, it will not help that the system offers great user-friendliness. This is why perceived ease of use does not affect intention to use directly. The connection between perceived usefulness and intention to use can be explained in the way that actual usefulness of using an information system will directly affect the intention to using it. If a user thinks that a new information system will increase his job performance it will have a positive effect on intention to use. Intention to use is also affected by the users attitude towards using the information system [30].

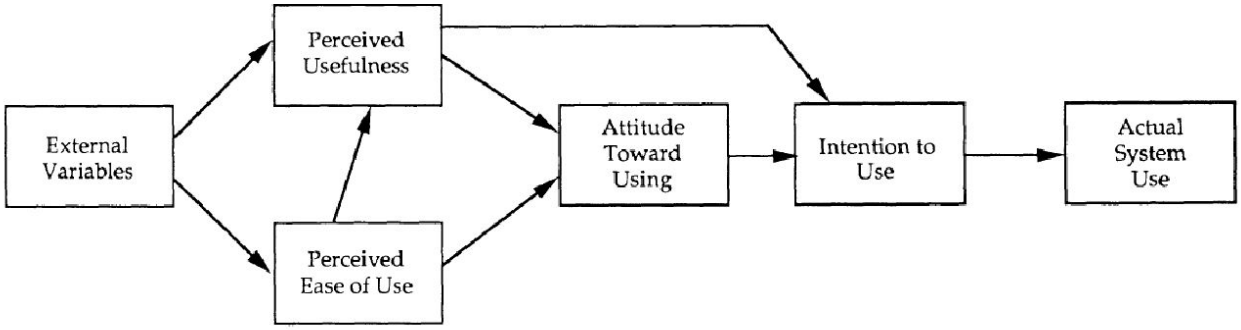


Figure 2.1: TAM (Adopted: (Davis1989)

summary

2.9 Success factors and barriers of mobile services.

Research by Ervasti [28] has proved that the success of mobile services not only depends on technological maturity of mobile technology and the penetration of mobile handsets; in the end, the users decide on the success of the services. The predictions are hard to make, but there are certain factors that need to be considered when developing mobile services. Rogers [64] has developed a set of key innovation characteristics, Rogers' basic five , later increased with two more factors [56] that influence the adoption and diffusion of new technologies throughout a social system: That is; Relative advantage, Compatibility, Complexity, Trial ability, observability, image , trust. Rogersínnovation attributes refer to the notion that mobile services are likely to be adopted if they offer a solution that has some clear advantages over existing products or services. Mobile services are also more likely to be adopted if they are compatible with the existing practices, values and skills of potential adopters, and are relatively easy to understand and use. If it is not possible to experiment with the service before making an adoption or rejection decision, and if the benefits offered by the service are not visible, then adopters are likely to perceive uncertainty and risk in adopting the service. [28]. Research has also proved that there are several factors inhibiting the use of services, since the technology maturity is no longer an obstacle. Development of technology is commonly seen as an important prerequisite, or even as a reason, for people to adopt new mobile services. According to Parasuraman (2000), the technology-readiness construct refers to peoples propensity to embrace and use new technologies for accomplishing goals in home life and at work. The dimensions affecting the technology readiness have been

identified as optimism, Innovativeness , discomfort and insecurity. The important attributes for innovation adoption set by [64] and [62] have not yet been taken into account to a sufficient extent when designing new mobile services. It might be the reason why the adoption and diffusion of mobile services has not proceeded as fast and wide as have been assumed. In light of the above therefore, restructuring of LMS for mobile device use will emphasize innovativeness optimism as well as ensure security for the system so as not to discomfort the users.

2.10 LMS design and implementation.(Research Gap).

According to Ssekakubo et al. [70], mobile phones were rated the least used devices for accessing LMS services, mainly due to inadequate design of LMSs for mobile interaction. It was also noted that majority of universities in developing countries, especially in Africa, view LMSs as the most appropriate e-learning tool in blended learning environments, and they (the LMSs) are often regarded as the starting point of any web-based learning program [7], [17], [39]. Research carried out by Matt et al. [38] and Brian [29] further highlighted that mobile phones present usability and compatibility problems while trying to access web sites meant for desktop or laptop computers, and this is indeed the main reason why students do not use them to access LMSs. Thus, if mobile phones are to be used to effectively access LMSs, the LMSs have to be optimized for mobile access.

Nelson (2012) demonstrates that the optimization of web sites for mobile phone access can be enhanced for mobile access in two ways: enable access to a fewer services through the mobile phone, but with all the necessary details for each service; or enable access to all the web site services through the mobile phone, but with little detail for each service. In a related study [69], it was noted that despite the increased adoption of LMSs by institutions in developing countries, their potential to support e-learning has not been fully exploited. Research by Alfred, et al [67] and Saeedikiya et al. [65] also noted that e-learning initiatives in general and LMSs in particular register relatively few users in developing countries, thereby not justifying the high infrastructure investment costs.

Ssekakubo [70] recommended that one way to attract and retain learners on LMSs is by identifying the LMS services that are most desired by the students, refactor the LMS and make such services more effectively and intuitively accessible by the students through

various technology platforms such as mobile phones. These findings are further supported by Mtebe's recent research [57], who demonstrated that clearly developed mobile phone-based LMS interfaces will inspire the students and lecturers to use their mobile phones to access LMSs.

Chapter 3: Methodology

3.1 Introduction

This chapter highlights the study design and approaches that were used, study population, sample size, data collection, presentation and analysis procedures as well as tools employed in the study. The study employed Design Science methodology which was used along User-Centered Design, participatory design and paper prototyping.

3.2 Design Science in Information Systems Research.

Information systems are implemented within an organization for the purpose of improving the effectiveness and efficiency of that organization [75]. Capabilities of the information system and characteristics of the organization, its work systems, its people, and its development and implementation methodologies together determine the extent to which that purpose is achieved.

In this study, we adopted design science methodology. This methodology involved the Environment, Design science research cycle and the Knowledge base. Our study followed these activities as emphasised in the 2004 MISQ paper. Hevner [33] also indicated that these three design science research cycles need to be identified and understood for the existence of any design research as illustrated below.

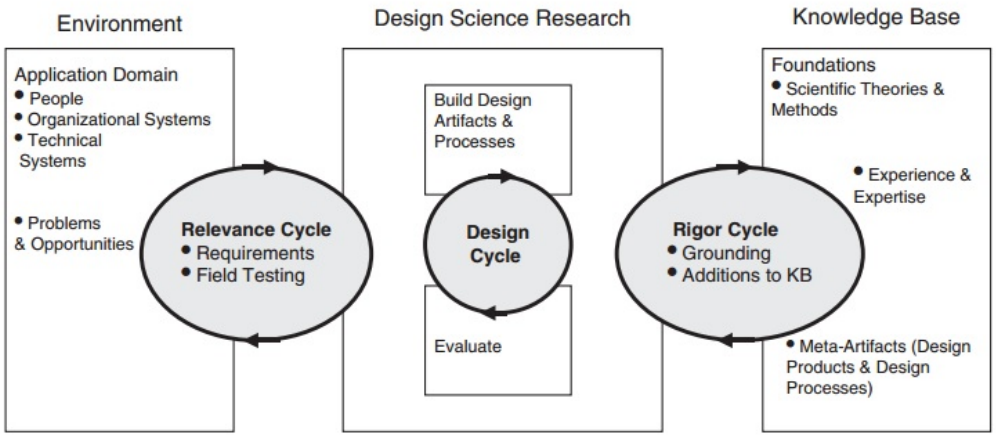


Figure 3.1: Design science research cycles (Adopted: (Hevner 2007)

3.2.1 Environment

In this research, the MUST community constituted the environment, both students and lecturers as well as the systems administrators who were actively involved with the LMS. After conducting a survey that was intended to establish why students and lecturers have not fully utilized LMS services, formed the core (Problems and opportunities) for the development of the design of the mobile phone based LMS (Artifact). Requirements were gathered using a questionnaire to establish the percentage of students who owned smart phones and would be willing to use their phones to access selected LMS services that were identified as important and needed by by users at MUST.

Data was collected from 200 participants, using random sampling technique where participants were randomly selected from each faculty / institute of the University.(FOM, FOS,ICS,IITR and IMS).

Faculty / Institute	Total Number of Students	Percentage(%)	Number of Participants
FACULTY OF SCIENCE	439	13	26
FACULTY OF MEDICINE	1070	32	64
INSTITUTE OF INTERDISCIPLINARY TRAINING AND RESEARCH	440	13	26
INSTITUTE OF COMPUTER SCIENCE	542	16	32
INSTITUTE OF MANAGEMENT SCIENCE	866	26	52
TOTAL	3357	100	200

Table 3.1: Sample Size of Participants involved in the study

As indicated in table 3.1,the study involved all faculties and Institutes of the University. Proportional Stratified random sampling was used where each faculty / Institute represented a strata, and sampling was performed separately within each stratum. Stratified random sampling was preferred because MUST faculties and Institutes had differing students' numbers as shown in table 3.1, and there was need to improve estimation for each Stratum separately so as to ensure adequate sample size for each group. Simple random sampling was used to select the respondents from each stratum. The overall sample of 200

participants, was obtained from the five faculties/institutes. This number was considered sufficient due to time and cost factors being adopted from the previous study conducted by Ssekakubo [69]. All participants were given a debriefing consent form in order to capture their expectations.

3.2.2 Design science research cycle

Building design artifacts and processes involved designing a mobile application for selected LMS services. This involved engaging users (Students and Lecturers) in co-design through participatory design approach as emphasized in the UCD approach. Paper prototyping was used where participants were given a chance to express their ideas and come up mockups illustrating how they wanted the mobile interfaces to appear and steps involved in achieving the the different activities. The mobile App was deployed for both for students and lecturers to start using from 13th August to 11th October, and System logs were closely monitored so as to monitor system accessibility and usage so as to ascertain whether there was an increase in usage of the system. The main reason for engaging users in the design process was to increase usability and acceptance of the system as advocated for in the TAM. (Perceived ease of use, perceived usefulness and intention to use the system) . [22].

3.2.3 Knowledge base.

This cycle helped the researcher to communicate his findings to the public after evaluating the artifact to ascertain whether mobile phone can be used to increase LMS accessibility and usage.

3.3 User-Centered Design (UCD).

User-Centered Design (UCD) was used alongside design science methodology. It is an approach that involves users in the decision-making and development process of an ICT solution [50]. User-Centered Design empowers users to have an active role in making choices and input during the design and development of an interactive education technology for learners. The researchers listened to learners' needs and requirements as well as considering the social, culture and technical context for the implementation of the system. Jones [50] documented the reported benefits of UCD: Increase of the communication between developers, end-user satisfaction, achieving expected benefits, among others. Thus, UCD provided the potential of empowering learners, and supported a transition from a role in which the

learner was only the passive recipient of education services to an active role in which the learners were involved in the design and decision-making process.

3.3.1 User-Centered Design (UCD) Processes.

User-centered design activities are arranged iteratively into four typical software development phase; Analysis, design, implementation and deployment. Figure 1 describes the activities of UCD.

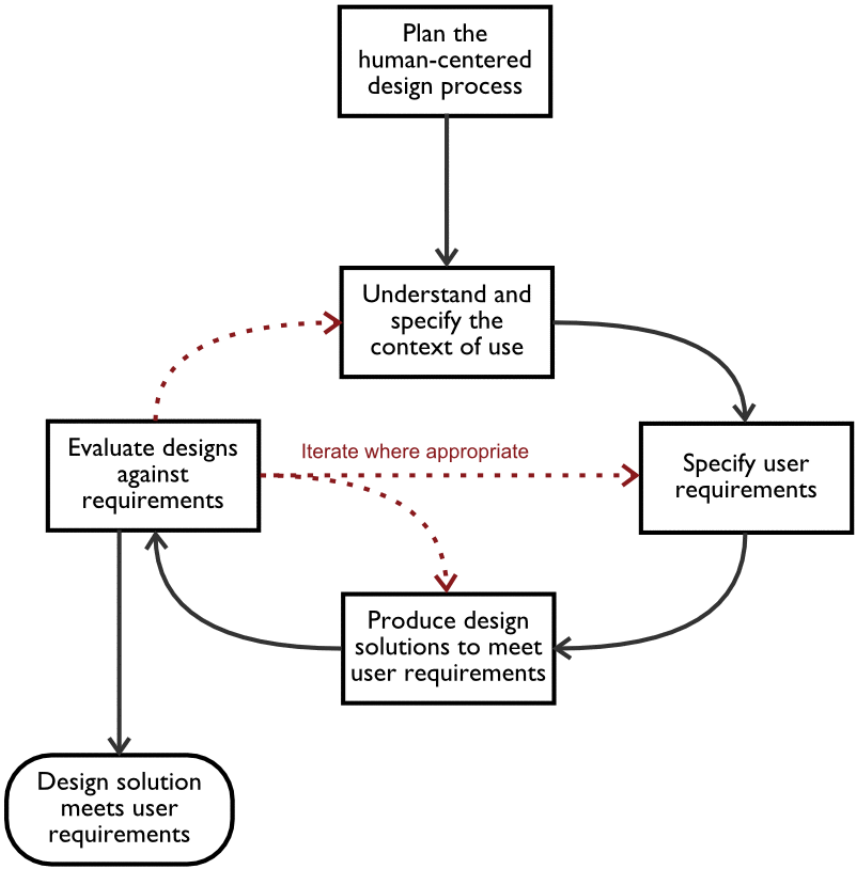


Figure 3.2: User Centered Design)

3.3.2 Step 1:Plan the human centered process.

After identifying the design needs using the results obtained from analysed data, the design team started planning which method to use during the distinct phases of the approach. Communication among the project team and teamwork was extremely important and prioritised.

3.3.3 Step 2: Specify the Context of use.

This involved knowing the environment where the system was being used. The system mainly target the MUST community, and in particular, LMS users who comprise of Students , Lecturers, System Administrators as well as Administrators.

3.3.4 Step 3: Specify user and organizational requirements.

This stage determined the tasks that users had to accomplish when using the system. The project team defined users and personnel involved using direct observation or contextual inquiry, and/or participatory design as emphasized by Jones [50].

3.3.5 Step 4: Produce design solution.

In moving towards the creation of a functioning system, the design team engaged users in co-design through participatory design approach. Paper prototyping was used and participants were brought together in workshop sessions to put their ideas on paper, with the help of the principle investigators.

3.3.6 Step 5: Evaluate design against user requirements.

Usability inspection methods, such as heuristic evaluation, user experience evaluation and focus group method were used to evaluate the designed system. The idea behind this testing was to assess the degree to which requirements were being achieved. Narratives and explanations of the study participants through think-aloud method or post-study open ended interviews were some of the techniques that were used to evaluate the system with the help of lecturers and system administrators of MUST.

3.4 Instruments and Ethical considerations

To address the first objective of the study, a questionnaire was developed (See Appendix A) and distributed to participants who willingly consented to participate in the study. Each participant was given a consent form that clearly outlined the purpose of the study. In the consent form, participants were informed that there were no incentives involved in the study and that data collected would be purely used for academic purposes. Participants were encouraged to participate in the study since there were no risks involved and they had a right to withdraw from the study and this would not affect them in anyway.

The inclusion criteria was based on all students who owned a smart phone. The questionnaire aimed at investigating the percentage of students who owned smart phones and would be willing to use their phones to access selected LMS services as well as the most important LMS services they wished to access using their mobile Phones / Tablets. Having reviewed literature from Ssekakubo's research [69] investigating the most important services needed by students from Makerere and UCT, researchers set out to affirm whether similar results would be obtained from MUST.

Content and validity of questions were reviewed by the MUST Research Ethics Committee (REC) and was approved as a suitable tool to collect data that would address the objectives of the study (See Appendix B). The questionnaire had three Sections. Section A, consisted of demographic data, Section B, Phone information and Section C was about the LMS.

Chapter 4: Presentation of Results and Discussions.

4.1 Introduction

In this chapter the researcher presents a contextual inquiry study conducted with the students and the lecturer at Mbarara University of Science and Technology. The goals of this study were to;

1. Understand a particular instance of the University, for example what happens, who does what and the limitations and benefits of the current system.
2. Observe the environment where the leaning management system was used.
3. Understand End user needs and requirements regarding the proposed intervention.
4. Establish a working relationship with the end user and the user staff at MUST.

4.2 Research Perspective

This dissertation is framed within the research area of ICT for development (ICT4D). Research studies in areas of ICT4D focuses on development issues. The concept of "sustainability" is important to consider in ICT4D studies. As a result, ICT4D experts advise researchers to develop interventions based on what people have, and what people can do. For instance, a mobile phone is an ICT tool that the majority of students at MUST own. Therefore, providing mobile phone-based LMS creates an opportunity for the University to explore alternative ways of increasing accessibility and usage of the LMS by students and lecturers because they will be able to access the LMS at their convenience, anytime and anywhere. It is anticipated that in the long run this will improve students' access to learning material which will in turn improve their performance.

4.3 Requirement Analysis, Fact-finding and Conceptualisation

The overall aim of this baseline study was to understand the current working environment of the Learning Management System at MUST, prior to the introduction of the proposed intervention. To ascertain the usage of the current LMS services at MUST, and assess the end-user needs, We conducted a study at Mbarara University of Science and Technology (MUST) using a questionnaire. A number of studies have recently emerged which have used this approach. Additionally, MUST was selected on the basis of its past and current use of Claroline LMS, and it was relatively easy for the researchers to interact with the LMS users since the principle investigator was a MUST student (2007-2010) and currently an employee of the same University. Therefore, the state of the University and challenges through the use of questionnaires where 200 participants participated in the study are presented.

4.4 Data Analysis

4.4.1 Results from the preliminary study

A preliminary study was carried out to establish the percentage of MUST students who owned smart phones, and would prefer to use their phones to access selected LMS services. This study was also important to get information about LMS awareness, usage and reasons as to why students had not used the LMS. This data was very important to justify the need to explore alternative ways of accessing the LMS via mobile phones. Data was collected using a questionnaire and SPSS 20.0 was used for analysis and interpretation. Frequency, mean, and percentage methods were used during the analysis process, which helped the researcher to generate summary tables and graphs which were used for the presentation of results as indicated below.

What Type of Phone do you have?

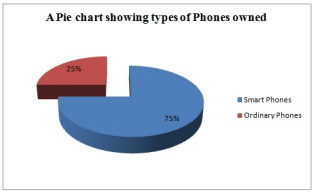


Figure 4.1: Type of Phone owned

As indicated in figure 4.1, it was established that majority of the participants comprising of 75% owned Smart phones. This was mainly attributed to the ever increasing demand for smart phones that has led to reduction in their prices making them affordable. It was also anticipated that if the LMS was restructured for mobile phone access, a considerable number of students would be motivated to own smart phones so as to explore the new technology with its benefits geared by the social influence factor that attracts more users to adopt to a technology because others are using the same technology. It is also on record that 76% of college students prefer native mobile apps over mobile web because they are faster. [15]

Have you heard of the MUST LMS

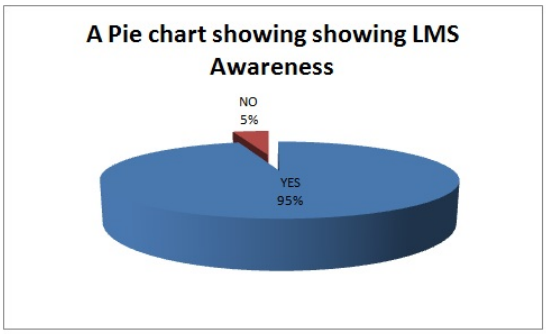


Figure 4.2: Knowledge about LMS

As indicated in figure 4.2, 95% of the participants had knowledge about the LMS and only 5% out of the 200 participants did not have any knowledge about the LMS. These findings implied the that majority of the participants knew about the LMS. This was mainly attributed to the publicity made about the LMS especially during students' orientation. The minority who did not have any knowledge about the LMS were mainly students who reported late and missed orientation.

Have you used the LMS before?

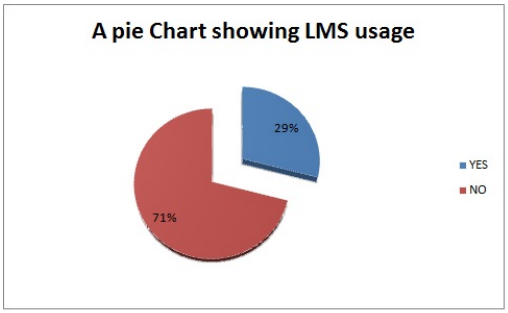


Figure 4.3: LMS usage

Results obtained in figure 4.3 indicate that 71% of the participants had not used the LMS. Much as majority of the participants had knowledge about the LMS as shown in figure 4.2, most of them had not used the system. This low usage of the LMS was very alarming yet the University continually invests a lot in terms of maintaining and upgrading the servers that consume a lot of power, Internet bandwidth dedicated to the LMS server as well as the technical team that ensures that the system is always running 24/7. Majority of the participants who had not actively used the LMS pointed out several reasons, of which NOT knowing how to use the LMS, lack of access to the LMS due to limited infrastructure and having no reason to access the LMS due to lack of content toped the list. Interviewed lecturers also pointed out design issues as a hindrance to the usage of the LMS. Being an open source software, the assumption that the system would address all the needs of users at MUST and be widely accepted by users was over exaggerated as pointed out by lecturers, highlighting the poor arrangement of content on the LMS among other design issues.

The researchers went ahead to find out why participants had not used the system and the following results were obtained.

Table 4.1 Showing why participants had not used the LMS

Why have you not used the LMS	Frequency	Percentage
Do not have access to the LMS	120	60.0
Do not know how o use the LMS	20	10.0
Have no reason to use the LMS	50	25.0
Others	10	5.0
Total	200	100

Table 4.1: Reasons for not using the LMS

As evidenced in table 4.1, majority of the participants (60%) did not have access to the LMS. This was because the computer labs would always be occupied with lectures, yet majority of the participants did not own personal computers to use to access the LMS. A considerable number of participants (20%) did not have any reason to access the LMS. This was due to failure by lecturers to post content to the LMS because there is no ICT policy regarding LMS usage. In an interaction with the lecturers, it was established that due to lack of access to the LMS, most students preferred hard copy lecture slides as opposed to LMS which could not be accessed. 10% of the participants did not know how to use the

system. This was mainly due to lack of exposure to the system and lack of training. 5% of the participants fell under others. These included lack of interest in using the system, personal preferences to reading hard copies to soft copies among others.

If the following devices for accessing the LMS were availed to you, which one would you prefer to use?

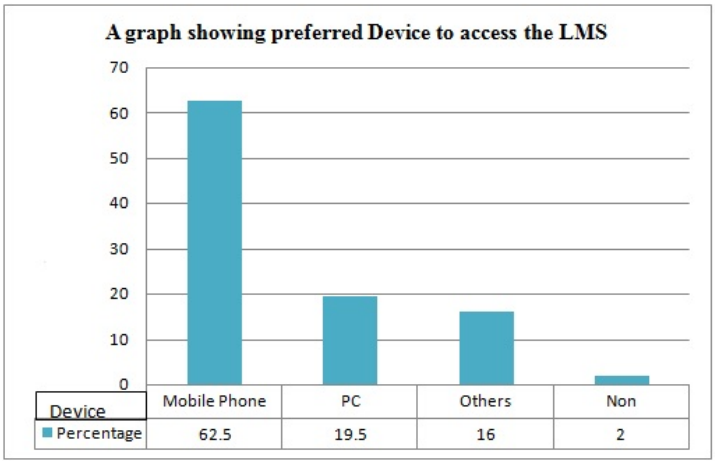


Figure 4.4: Preferred Device to access the LMS

When participants were asked the preferred device to use to access the LMS, majority (62.5%), as indicated in figure 4.4, preferred using their mobile phones. This is mainly for convenience purposes and ability to access LMS services anytime and anywhere. However, 19.5% preferred using their personal computers (Laptops) mainly because they have a bigger screen as compared to a smart phone and higher storage capacity. However much as laptops were ranked second to mobile phones, they are very expensive to be afforded by all students hence leaving mobile phones as the best option.

To further confirm the results in figure 4.4 above, participants were asked whether they would be motivate to use the LMS if it was accessed via a mobile phone and the following results were obtained.

If the LMS was accessible via a mobile phone, would you be motivated to use it?

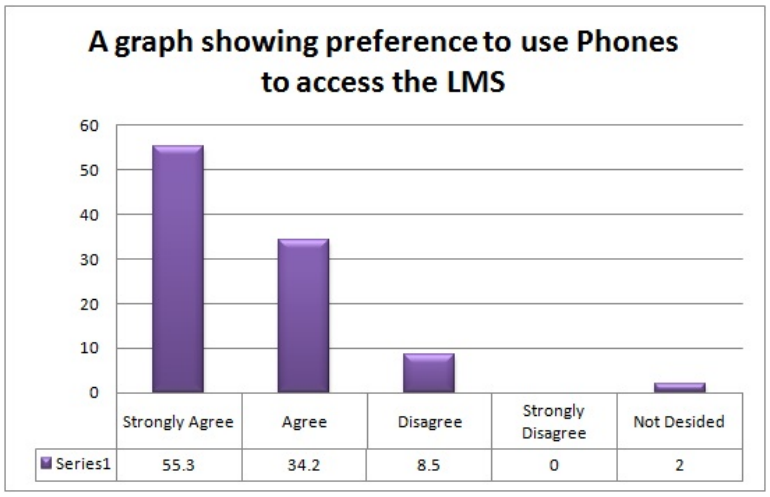


Figure 4.5: Preference to using a mobile phone to access LMS services

Results obtained in figure 4.5 indicated that 55.3% strongly agreed, 34.2% Agreed, 8.5% disagreed whereas 2.0% where not decided. These were very motivational findings implying that majority of the participants were willing to use the new system. Basing on these findings, it was highly anticipated that the user acceptability of the system will be high hence there was need to identify the most important services needed by users at MUST. The main reason for having a few selected services is highlighted in ssekakubo's research hence forming the foundation for objective one of the study.

4.5 Results for Objective 1

4.5.1 LMS services

The first objective of the study was to investigate the most important LMS services needed by users. Six services were selected according to Ssekakubo [69], who had identified them as the most needed services. These services included course outlines, downloads, announcements, SMS alerts, assignments and chatting. Participants were asked the extent to which they either agreed or disagreed that these services were the most important and most needed. Majority of the participants indicted that they strongly agreed, followed by Agree, and few disagreed. This therefore conforms to the findings of previous researchers that they are the most important and required services needed by LMS users, not only else where, but also at MUST.

The main reason for having a few selected services was advocated for by ssekakubo [69] who recommended that one way to attract and retain the learners on the LMSs is by

identifying the LMS services that are most desired by the students, re-factor the LMS and make such services more effectively and intuitively accessible by the students through various technology platforms such as mobile phones.

Using a questionnaire, participants were asked to rack these LMS services using the Likert Scale, and the following results were obtained as indicated in the respective figures.

Figures 4.6 to 4.11 show results obtained from participants when they were ask The extent to which they either Strongly Agreed, Agreed, Undecided, Disagreed or Strongly Disagreed that the following LMS services were very important and needed by users at MUST

Results for Course Outline Service

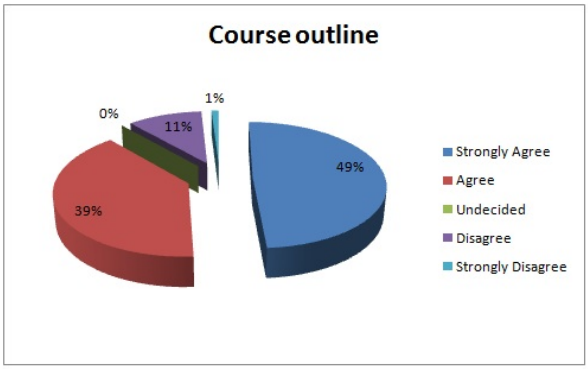


Figure 4.6: Course Outline

Course outline is a brief summary of the topics covered in a particular course. It is a document that outlines the entire structure of a particular course, and it includes the following. Title of course and course code , Description of the course consistent , Course prerequisites , Course Objectives , Student learning outcomes , Topical outline of the course content , Guidelines/suggestions for teaching methods and student learning activities ,Guidelines/suggestions for methods of student assessment (student learning outcomes), Suggested readings, texts, objects of study , Bibliography of supportive texts and other materials , Preparer's name and date.

It was established that this is a very important service required by both students and lecturers. Majority of the participants strongly agreed with the need to have this service because it is a guiding factor that helps student know their expectations from the course and also to plan for the semester accordingly.

Results for Downloads Service

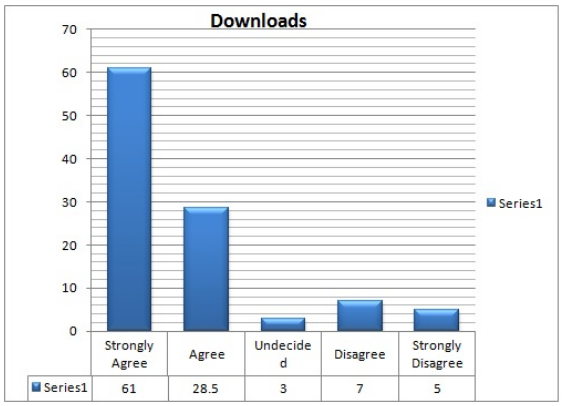


Figure 4.7: Downloads

Downloads include all course material that can be uploaded by lecturers and downloaded by students. These course material may include lecture notes and slides, textbooks, reference materials among others. Lecturers could also upload links to other study materials like videos and other sites which students could access for more details. Majority of the participants strongly agreed that downloads was a very important service needed for them to access on the LMS. This service helped system users to always access learning materials at anytime and anywhere. Students would download the reading material on to their phones for access during during the offline LMS mode. The few students who disagreed with the importance of this service pointed out limited phone storage space as a major hindrance to this service. Therefore, for this service to effectively be used, there was need to compress the uploaded material to portable document format (pdf) and also encourage users to supplement their internal storage with memory cards which are affordable, as compared to the cost of having to always rely on printing and photocopying notes.

Results for Announcements Service

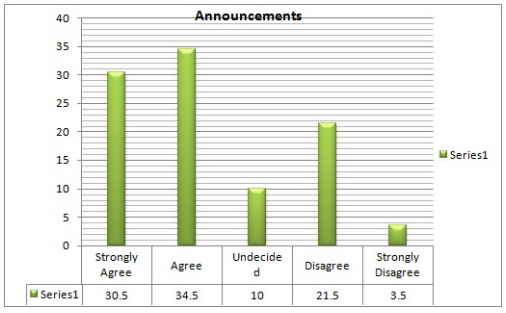


Figure 4.8: Announcements

MUST has continued to rely on the traditional notice boards method of disseminating information for both students and lecturers even when such information could easily be disseminated electronically. This has made both students and lecturers miss out important information published on the ever congested notice boards with even out dated notices being labeled "NEW!!!!", making it hard for readers to distinguish new notices from old notices. There is also a tendency of selfishly removing important information by the first readers before being seen by everyone. The announcements service was preferred by participants because it was seen as "Saviour" to save them from missing of important information. Lecturers would also be able to effectively communicate with students by posting all the important information timely.

Results for SMS Alerts Service

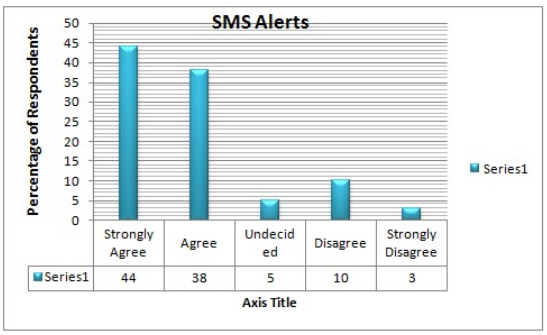


Figure 4.9: SMS Alerts

During the study, participants were requested to mention any other service they deemed important with justification. After analysing the results, a considerable number of participants had had indicated how SMS alerts service was of great importance. This service was in favour of the minority group that did not own smart phones. This service would help to update system users every time a lecturer uploads notes all posts an announcement, and all registered targeted users would receive a notification inform of an sms alert so that they could quickly check it out. This service was preferred by student because it ensured real time updates across all system users.However, this service had a set back because it involved sms costs and costs for acquiring the sms gateway.

Results for Assignments Service

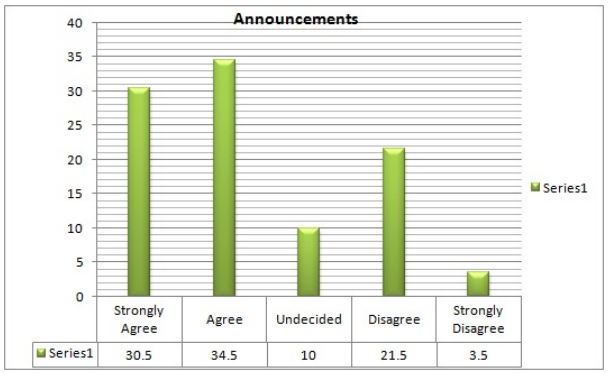


Figure 4.10: Assignments

The online assignments service was another service that participants perceived to be important. It would allow lecturers to post assignments online and student would able to download the assignments without necessarily having to physically meet with the lecturer. Students would re-upload the assignment for the lecturer to mark. Feedback regarding the assignment could as well be posted and shared with students. However, some section of the participants who disagreed and would prefer to have printed out assignments since it is not possible to do the assignment using the phone. Others urged that assignments which involve symbols like mathematical equations would present several challenges, hence would require additional efforts of printing which may not be cost effective.

Results for Chatting Service

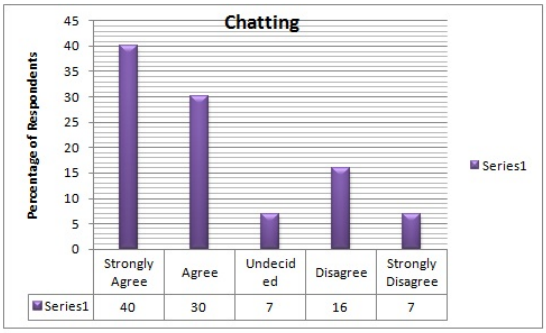


Figure 4.11: Chatting

This was the last service discussed with participants. This service was ranked important because of the new trends in communication like whatsapp and facebook messenger. The service was vital for ensuring communication between students and students as well as

students and lecturers. The service would help students share and exchange constructive learning information like reminders to attend lectures, inviting them for discussions among others.

4.6 Results for Objective 2

4.6.1 Participatory Design

Participatory design aims at including users in the design process so that users' voice is reflected in the design of a technology they use [14]. The end users (beneficiaries of the system) played a critical role in designing of the system, as opposed to the top-bottom approach that emphasizes greater use of theoretical perspectives that are not founded on the rational and mechanistic view of the end user. Having participated in the design process made end users accountable in the design decisions made about the final system which increased their level of satisfaction, confidence and acceptability of the system. The core methods of participatory design employed in the study included workshops and design sessions in which users were encouraged to think creatively and propose their own ideas.

4.6.2 LMS Mobile App Design

In our previous work, we conducted a study with LMS users at MUST in order to understand how Claroline LMS works and assess the end user needs. We observed some design issues regarding the system. For example, the system had several services some of which were not being used. Among other issues highlighted by users was lack of proper sorting on data, as well as difficulties in accessing the system if accessed using mobile phones, because the system structure and architecture were intended for desktop access. These were cross cutting issues among all the participants.

In order to assist in restructuring the current LMS for mobile phone use, we organised a workshop in which users from MUST were grouped into five different groups, each comprising of five participants with representation from all years of study (1-5) as well as a representative from each faculty / Institute. We felt that the 25 participants used were sufficient for the study. Participants were further briefed that they were users of the proposed technology and that they were going to be involved in designing of the LMS mobile APP. Thus, as users, they knew their specific needs and their involvement in the design would ensure use of the system. These groups were closely supervised by the principle investigator.



Figure 4.12: Participatory Design Workshop sessions

Snyder [68]; Emphasised that it is very important to brief participants about the introduction to paper prototyping technique, hence the following aspects were clearly explained to the participants.

1. Introduction of paper prototyping. This included the history, significance and how it relates to participatory design.

2. Participants creativity was encouraged and they were were also informed that there was no right or wrong answer during paper prototyping. This motivated all members to actively contribute during the sessions.

3. Samples of paper prototypes were shown to participants in order to stimulate their designs, and the principle investigator provided the requirements like papers, pens and pencils that were used during the designing process.

The five groups worked independently in the development of the prototypes. At the end of the sessions, several requirements were produced, and All members in each group developed

the prototypes as a team. To justify their choices,all groups came together to present their designs and share their ideas and motivation that stimulated the production of the paper-based LMS mobile APP design. At the end of the session, a walk through was done in order to identify any issues that could have been missed or ignored. Each group then started developing their final prototypes with the researcher as the facilitator.

4.6.3 Evaluation of the Paper Prototypes

At this stage, our goal was not to come up with a complete design but to gather more requirements through paper prototyping. Each group provided two incomplete screens and several issues were identified by the principle investigator with the prototypes; incomplete interfaces and reluctance from two of the groups to sketch the interfaces. Simplicity towards the interface/screen designs was the first observation noted by the principle investigator. In order to harmonise all the functionalities that appeared on the screens, there was need to strike a balance between these functionalities and the number of steps needed to accomplish the needed task. (The most important LMS services that are frequent accessed on the LMS).

Example of paper prototypes

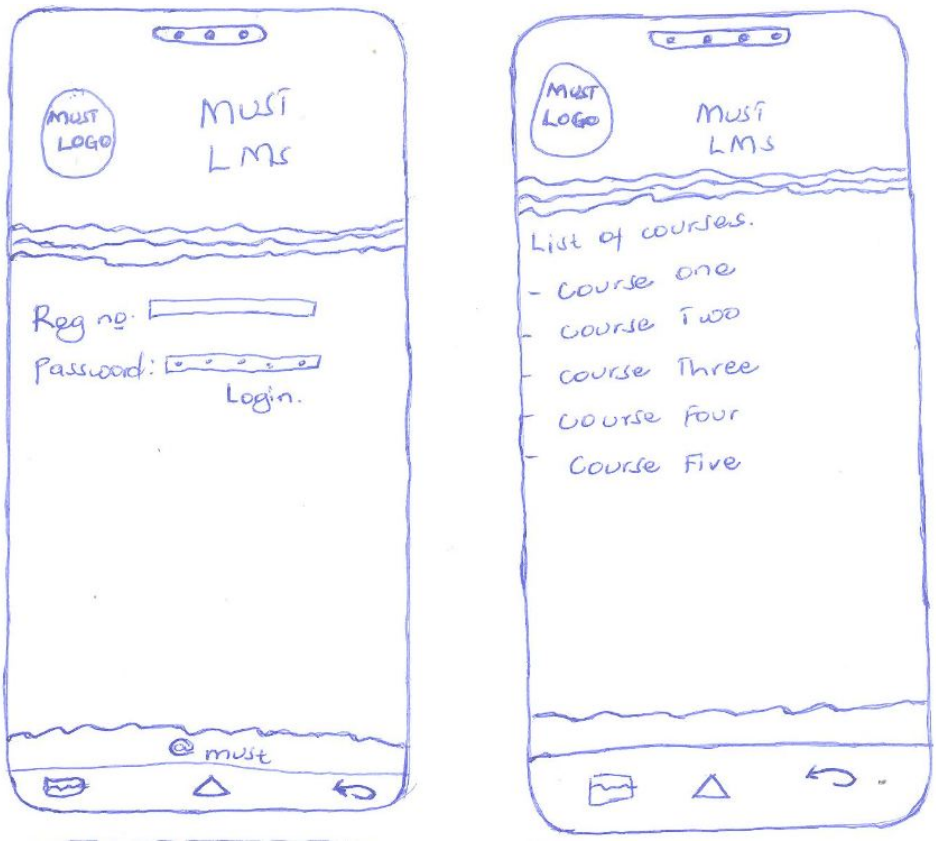


Figure 4.13: Hand drawn paper prototype 1

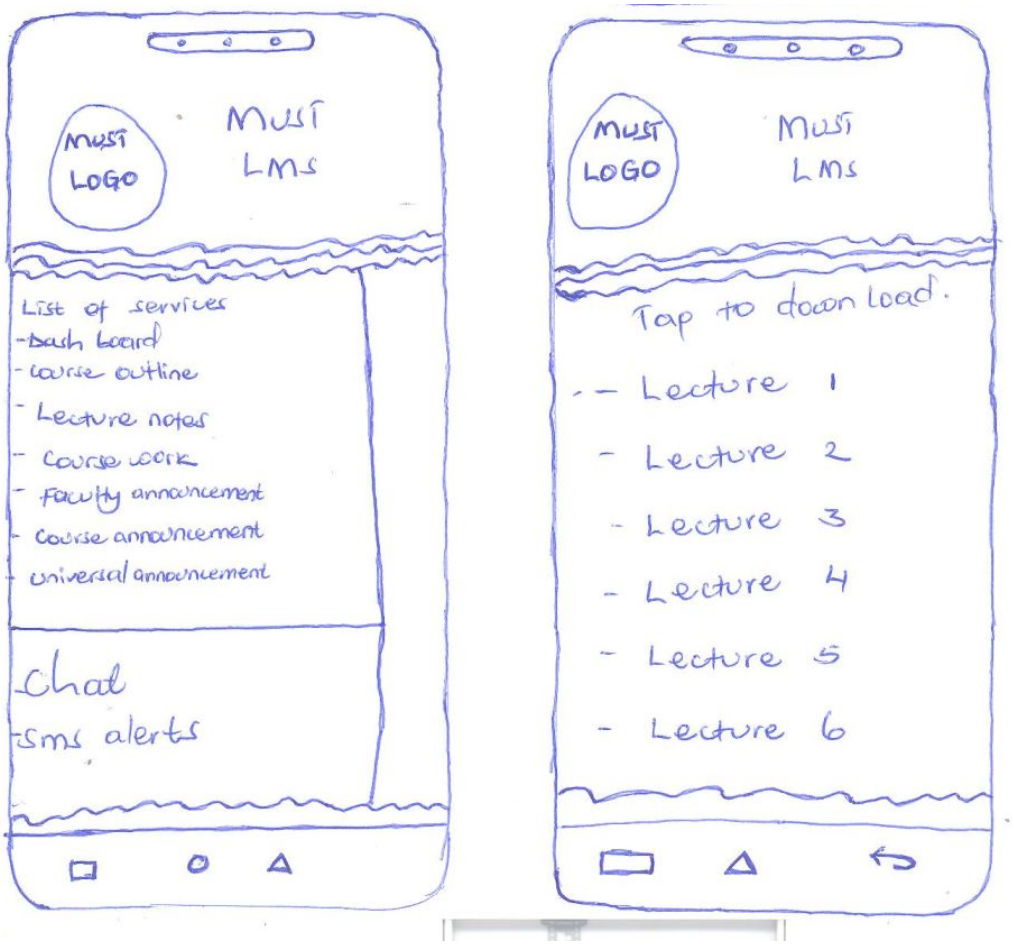


Figure 4.14: Hand drawn paper prototype 2

Figures 4.14 and 4.14 shows one of the finest paper prototype that was produced by one of the groups.

After analysing all the paper prototypes, we came up with the final design that shows how the system would flow as well as the interfaces and steps a student would go through to access the services.

Paper based final prototype.

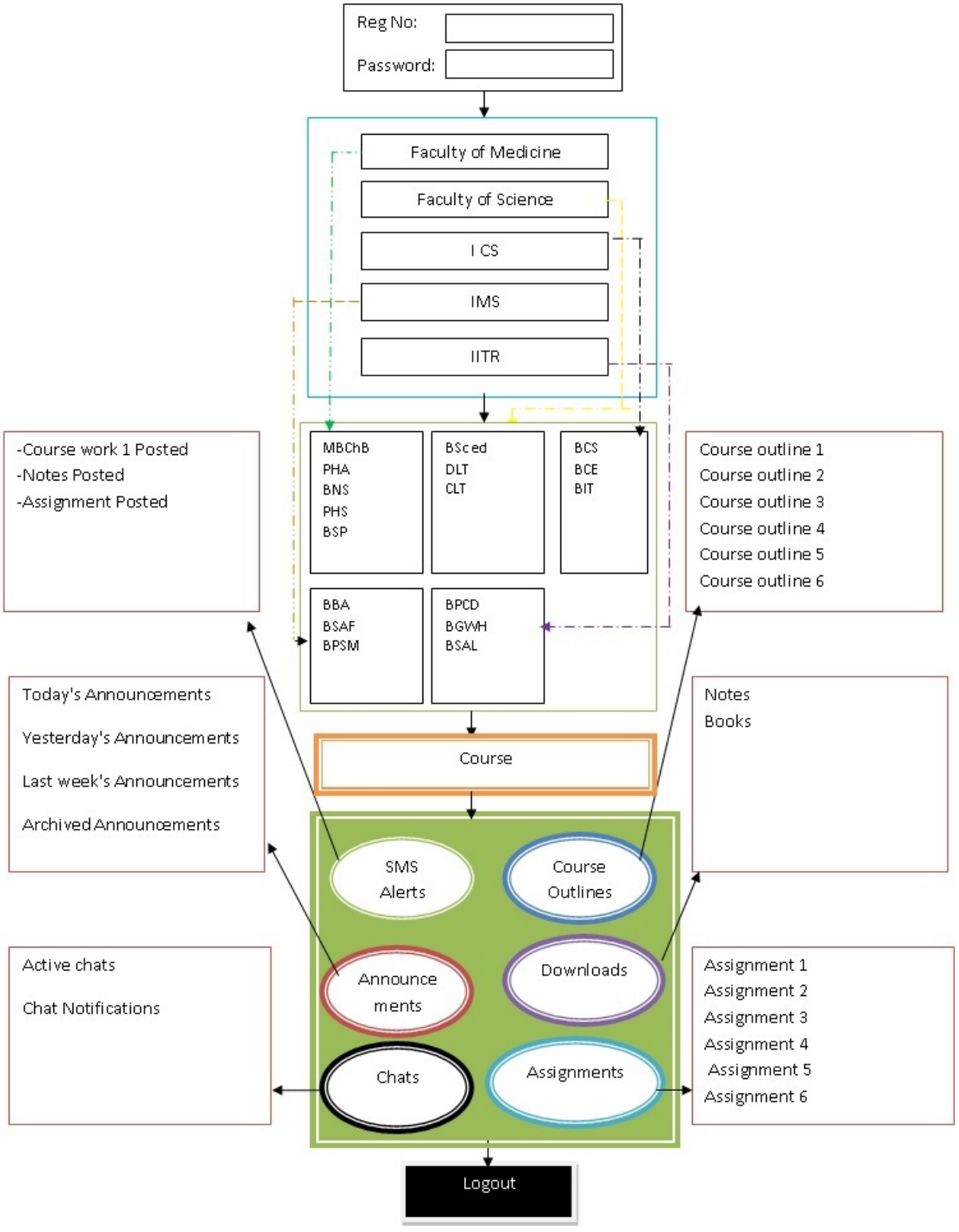


Figure 4.15: Paper Prototype

4.7 Results for Objective 3

4.7.1 Moving from design to development

The third objective of the study was to develop a mobile phone based LMS for selected services. The development process involved converting the paper based prototype which was designed together with users into a working prototype. The process started with interpreting the paper prototype into a logical database that would match the users' interfaces using visual paradigm. Mysql 5.6.12 was used to covert the logical design into a physical database. Care was taken at this stage not to change user requirements during the development process.

HTML, java script and Netbeans were used to develop user interfaces. At the server side, php was used to link interfaces to the databases as well as sever side and client side validation. Java was the main language used for the development of the mobile App using Android studio. To cater for all android versions, compilation was based on a lower version of android 4.0.

The database was hosted on a remote server where the administrator was able to create user accounts for lecturers, who were later provided with the URL to login into the system and start uploading content. Students usernames and passwords were synchronised with their personal students accounts used to log in to CEMAS, which is the main University system. This saved the researcher time to create accounts for all students and also helped to reduce on data duplication.

4.7.2 Screen Elements of the Mobile phone based LMS.

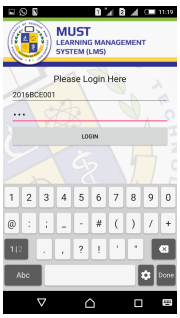


Figure 4.16: Login Screen

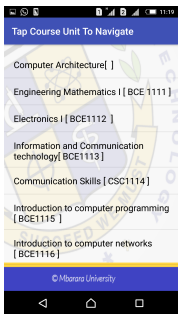


Figure 4.17: Course Navigation



Figure 4.18: Course Menu

Figure 4.16, shows the login screen which prompts the user to enter their Registration number and password for verification. The verification process checks for the students program and year of study. Upon verification, the student is directed to figure 4.17 which lists all the courses registered within that program for that particular year and semester. The student is prompted to select a course, and upon selection the course menu welcome page is displayed as indicated in figure 4.18 prompting the student to tap the menu on the top left corner of the screen.

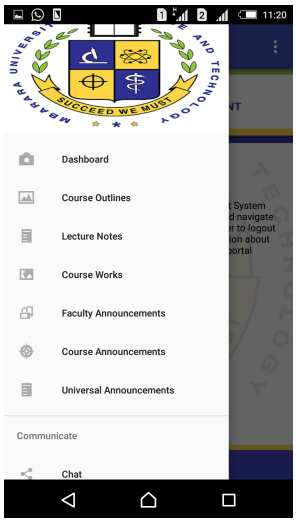


Figure 4.19: Menu Items



Figure 4.20: Download page

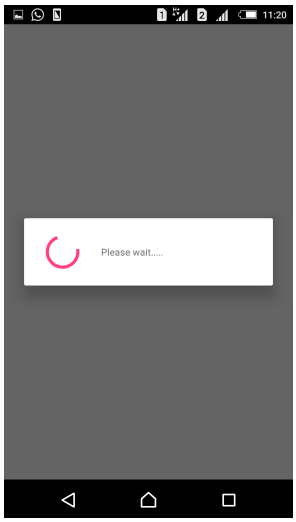


Figure 4.21: Download Status

The course main menu shows all the LMS services as discussed in the in objective one as indicated in figure 4.19. The system was designed in a way that these services are attached to a particular course. This explains why users have to first select a course, that leads them to the menu items. A user can select any of the services for example , like lecture notes as indicated in figure 4.19. On selection, a list of uploaded lectures will be displayed for for the student to download as indicated figure 4.20. Figure 4.21 shows the download status. Download time depends on the file size and speed of the internet. Once the file has successfully been downloaded, it will automatically open for the user to read.

On successful installation of the App, a fold named LMS is automatically created, and Subfolders for each downloaded course will be created within this folder to help in sorting out of the data as indicated in figure 4.22 and 4.23 respectively.

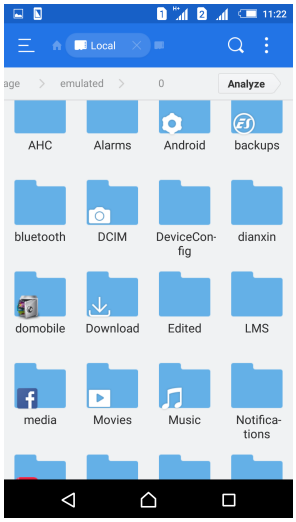


Figure 4.22: LMS folder

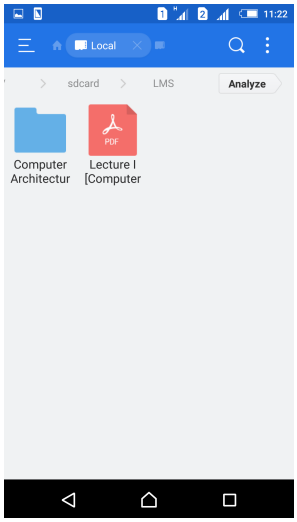


Figure 4.23: Sub folders

4.8 Results for Objective 4

Objective four of the study was to " ***To evaluate whether there is an increase in accessibility and usage of LMS services"*** with the intervention of the mobile phone based lMS.

The system was deployed for a period of two months and half between August to 11th October due to time constraint. System logs were closely monitored and a comparison was made between the Claroline LMS which is web based and the new mobile phone based LMS and the following results were obtained.

4.8.1 Results from the Claroline LMS before mobile LMS

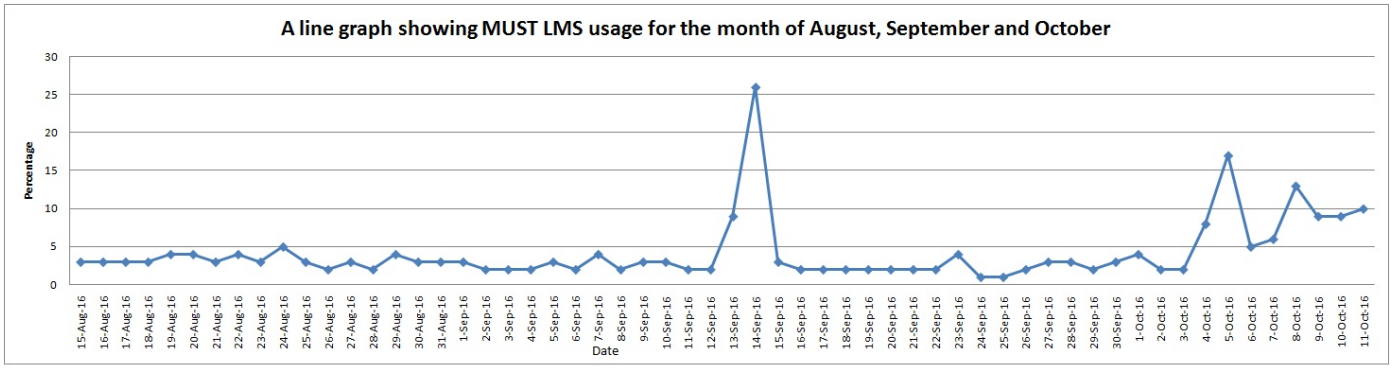


Figure 4.24: Claroline LMS statistics for the month of August,September and October

Results obtained from the system logs for the month of August, September and October as of 11th October 2016 indicated that the over all LMS usage was at 10%, 13% and 6% respectively.

There was an increase in the LMS usage during the month of September from 10% to 13%. It is believed that the very low system usage during the month of October was due to the mid-semester examinations where by students could not have access to computer labs and being busy revising for exams.

4.8.2 Results from the mobile phone based LMS

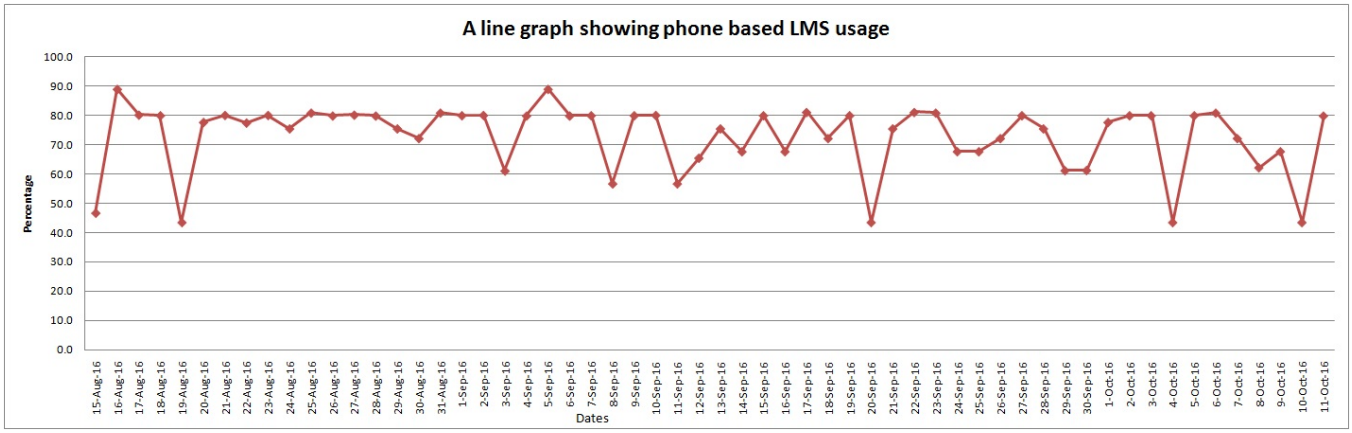


Figure 4.25: Mobile Phone based statistics for the month of August, September and October

As indicated in figure 4.25, there was an increase in the LMS usage for the time the system was deployed. This was mainly attributed to increased access to the system and emphasis by lecturers, encouraging students to explore the new technology. On average, usage for the system basing on the system logs was 70.3, for the period the system was deployed.

4.8.3 Comparison between the two LMSs

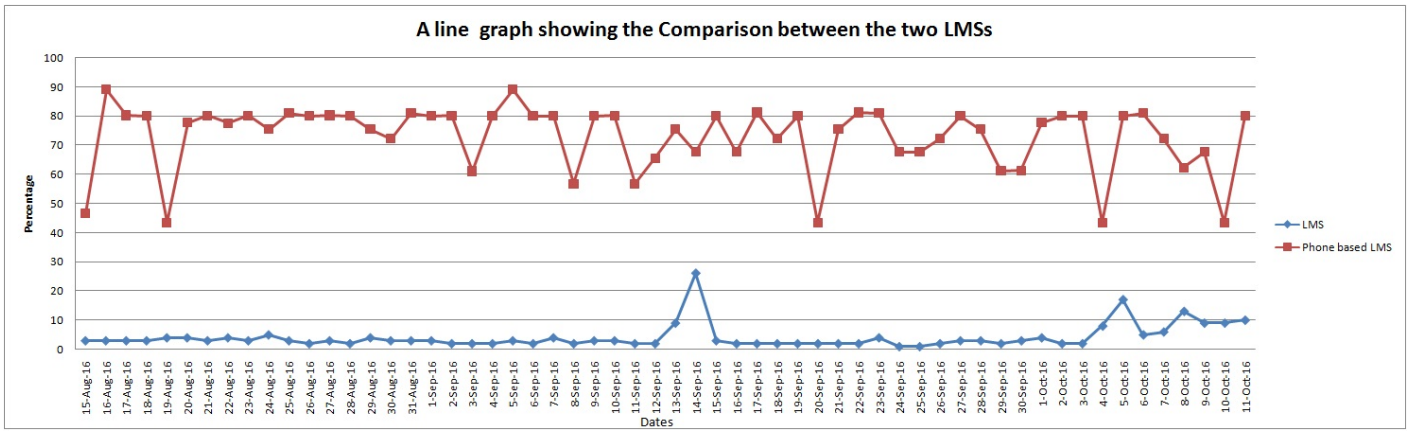


Figure 4.26: Comparison between Claroline LMS and the Phone based LMSs

4.8.4 Average usage between the two LMS systems

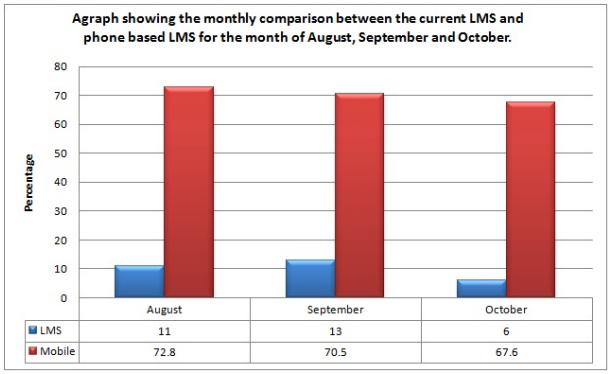


Figure 4.27: Monthly Average usage between the two LMSs

Figures 4.26 and 4.27 show a comparison between the two LMSs for the months of August, September and October as of 11th October 2016. It is evident there was an increase in the LMS usage through out the first months of testing when the mobile phone based LMS was deployed. These results are mainly attributed to increased accessibility of the LMS and convenience. The social influence factor can not be ignored in explaining these trends due to excitement to explore the features and functionality of the new technology. System logs indicated that the mobile phone based LMs was accessed at all times including night hours, as opposed to Claroline LMS which is mainly accessed during the day when students have access computer Labs when their are no scheduled lectures.

Chapter 5: Conclusion and recommendations.

5.1 Conclusion

In this study, we present our initial experiences and results in designing mobile phone-based LMS for MUST. Findings indicate that 75% of the participants owned smart phones and expressed high interest in exploring new alternative ways of accessing the system using their mobile phones. This was a great motivation and an indicator that the LMS would be accessed by majority of the students if access was via a mobile phone. Results further indicated that much as 95% of the participants had good knowledge about the LMS, only 29% had used the LMS and and the remaining 71% had never used the LMS mainly due to to lack of access, hence restructuring the LMS for mobile phone use was a viable solution worth exploring to increase access and usage of the LMS.

The study was also in agreement with the findings by sekakubo [69]that Assignments, Downloads, Announcements and chatting were the most important and required services required by users not only at the University of Cape town in South Africa and Makerere in Uganda, but also at MUST. However, the study also found out that sms alerts is a very important service that should be incorporated in the LMS. This service is important because it favours even students without smart phones by sending notifications about any updates on the system. For purposes of saving data and battery, some students who own smart phones always turn off their data. One of the ways they can easily be notified about any updates on the system is through sms alerts which will prompt them to turn on the data to access the updates.

Involving users in the design process is key to increasing system useability and acceptance because users were motivated to use the system especially when all their requirements had been addressed as in the design. Therefore system designers should always involve users in the design process using the different techniques available like Participatory design and paper based prototyping. Developing with the users as opposed to developing for users makes users

accountable to the final system, hence increasing their level of confidence, acceptability and use of a technology.
During development, care should be taken not change or ignore user requirements. Simplicity and functionality should be key at this stage. This is because when a system is user friendly, it directly affects the perceived ease of use and perceived usefulness of the system which will intern affect the attitude towards using the system and intention to use the system.

The Preliminary results obtained in the first three months of August, September and October showed that there was an increase in the LMS usage when it was being accessed on the mobile phone. Because majority of the students owned smart phones, students found it flexible and interesting to access the the LMS at there convenience. This increase in usage is also attributed to users' involvement in the design process because the system was developed with the intended users who felt accountable to the final system.

5.2 Recommendations

Most of the students access the LMS through wireless connection. However, the wireless connection at MUST is very unstable yet purchasing of data bundles is expensive for the students. It is against this background therefore that the researchers recommend improvement of the internet infrastructure if mobile LMS is to effectively be implemented.
There is also need for top management support regarding the LMS usage. This can be achieved by including the LMS usage in the ICT policy and made mandatory for every lecturer to upload content onto the systems. However this calls for infrastructural improvement especially regarding the internet bandwidth.

5.3 Limitations

The biggest limitation in this research was poor internet connectivity because participants relied on the University wireless connectivity which was very unreliable.

Due to time and cost constraint, the study was not able to carry out a controlled experiment that would give an insight in the amount of data consumed by the mobile phone based LMS. This would help to evaluate users' satisfaction more especially as regards the cost of data that would encourage students to use the system.

5.4 Future Work

There is need to evaluate the effectiveness and students' satisfaction towards mobile based LMS. This will help to ascertain whether Mobile phones can satisfactorily be used as an alternative way of accessing the LMS.

There is also need to integrate the LMS with administrative system that records student grades so that students can be able to have access to all their academic records through their phones.

References

[1] Mitchell Aboulafia. *Philosophy, social theory, and the thought of George Herbert Mead*. SUNY Press, 1991.

[2] Chadia Abras, Diane Maloney-Krichmar, and Jenny Preece. User-centered design. *Bainbridge, W. Encyclopedia of Human-Computer Interaction. Thousand Oaks: Sage Publications*, 37(4):445–456, 2004.

[3] Sam S Adkins. The africa market for self-paced elearning products and services: 2011-2016 forecast and analysis. *Monroe, WA: Ambient Insight*, 2013.

[4] Jessica Norah Aguti. Facing up to the challenge of universal primary education (upe) in uganda through distance teacher education programmes. In *Pan-African Commonwealth Forum on Open Learning: Transforming Education for Development, Durban, South Africa*, 2002.

[5] Hafsa Ahmed and Fauzia Kurshid. Use of information and communication technology (ict) among public and private sector universities in teaching and learning process. *Scholedge International Journal of Multidisciplinary & Allied Studies ISSN 2394-336X*, 2(4):25–36, 2015.

[6] Icek Ajzen and Martin Fishbein. Understanding attitudes and predicting social behaviour. 1980.

[7] John Akeroyd. Information management and e-learning: Some perspectives. In *Aslib proceedings*, volume 57, pages 157–167. Emerald Group Publishing Limited, 2005.

[8] Abdurrahman Ghaleb Almekhlafi and Farouq Ahmad Almeqdadi. Teachers' perceptions of technology integration in the united arab emirates school classrooms. *Educational Technology & Society*, 13(1):165–175, 2010.

[9] Annika Sophie Andersson and Åke Grönlund. A conceptual framework for e-learning in developing countries: A critical review of research challenges. *The Electronic Journal of Information Systems in Developing Countries*, 38, 2009.

[10] Carmelo Ardito, Maria Francesca Costabile, Marilena De Marsico, Rosa Lanzilotti, Stefano Levialdi, Teresa Roselli, and Veronica Rossano. An approach to usability evaluation of e-learning applications. *Universal access in the information society*, 4(3):270–283, 2006.

[11] Jonathan Arnowitz, Michael Arent, and Nevin Berger. *Effective prototyping for software makers*. Elsevier, 2010.

[12] Lucy Avraamidou. Prospects for the use of mobile technologies in science education. *AACE Journal*, 16(3):347–365, 2008.

[13] Izak Benbasat and Robert W Zmud. Empirical research in information systems: the practice of relevance. *MIS quarterly*, pages 3–16, 1999.

[14] Keld Bødker, Finn Kensing, and Jesper Simonsen. *Participatory IT design: designing for business and workplace realities*. MIT press, 2009.

[15] Kyle Bowen and Matthew D Pistilli. Student preferences for mobile app usage. *Research Bulletin)(Louisville, CO: EDUCAUSE Center for Applied Research, forthcoming), available from http://www. educause. edu/ecar*, 2012.

[16] Nadire Cavus. Investigating mobile devices and lms integration in higher education: Student perspectives. *Procedia Computer Science*, 3:1469–1474, 2011.

[17] Nadire Cavus, Huseyin Uzunboylu, and Dogan Ibrahim. Assessing the success rate of students using a learning management system together with a collaborative tool in web-based teaching of programming languages. *Journal of educational computing research*, 36(3):301–321, 2007.

[18] Lockias Chitanana, Daga Makaza, and Kudakwashe Madzima. The current state of e-learning at universities in zimbabwe: Opportunities and challenges. *International Journal of Education and Development using ICT*, 4(2), 2008.

[19] Maree Conway, Godfrey Maleko Munguatosha, Paul Birevu Muyinda, and Jude Thaddeus Lubega. A social networked learning adoption model for higher education institutions in developing countries. *On the Horizon*, 19(4):307–320, 2011.

[20] Maria Francesca Costabile, Marilena De Marsico, Rosa Lanzilotti, Vito Leonardo Plantamura, and Teresa Roselli. On the usability evaluation of e-learning applications. In

System Sciences, 2005. HICSS'05. Proceedings of the 38th Annual Hawaii International Conference on, pages 6b–6b. IEEE, 2005.

[21] Declan Dagger, Alexander O'Connor, Seamus Lawless, Eddie Walsh, and Vincent P Wade. Service-oriented e-learning platforms: From monolithic systems to flexible services. *Internet Computing, IEEE*, 11(3):28–35, 2007.

[22] Fred D Davis, Richard P Bagozzi, and Paul R Warshaw. User acceptance of computer technology: a comparison of two theoretical models. *Management science*, 35(8):982–1003, 1989.

[23] Erik Ed de Corte, Lieven Ed Verschaffel, Noel Ed Entwistle, and Jeroen Ed Van Merriënboer. *Powerful learning environments: Unravelling basic components and dimensions.* Pergamon/Elsevier Science Ltd, 2003.

[24] Robert P Dolan and Tracey E Hall. Universal design for learning: Implications for large-scale assessment. *IDA perspectives*, 27(4):22–25, 2001.

[25] Sibusisiwe Dube and Elsje Scott. An empirical study on the use of the sakai learning management system (lms): Case of nust, zimbabwe.

[26] Ikleel Elmahadi and Izzeldin Osman. A study of the sudanese students' use of collaborative tools within moodle learning management system. In *IST-Africa Conference and Exhibition (IST-Africa), 2013*, pages 1–8. IEEE, 2013.

[27] LLC Epignosis. E-learning concepts, trends, applications, 2014.

[28] MA Ervasti. The development of mobile service concepts-technologies, adoption and use'. *Master's thesis, University of Oulu, Department of Electrical and Information Engineering, Finland*, 2007.

[29] Brian Fling. *Mobile Design and Development: Practical concepts and techniques for creating mobile sites and web apps.* " O'Reilly Media, Inc.", 2009.

[30] Martin Grønland. User acceptance of information technology: An empirical study of it's learning. 2010.

[31] Said Hadjerrouit. Developing web-based learning resources in school education: a user-centered approach. 2010.

[32] Farideh Hamidi, Maryam Meshkat, Maryam Rezaee, and Mehdi Jafari. Information technology in education. *Procedia Computer Science 3 (2011) 369373*, pages 1–10, 2011.

[33] Alan R Hevner. A three cycle view of design science research. *Scandinavian journal of information systems*, 19(2):4, 2007.

[34] Sarah Hoosen and Neil Butcher. Ict development at african universities: The experience of the phea educational technology initiative. *Proceedings of e/merge*, 2012.

[35] Fathi Mahmoud Ihmeideh. Barriers to the use of technology in jordanian pre-school settings. *Technology, Pedagogy and Education*, 18(3):325–341, 2009.

[36] Erol İnelmen. World journal on educational technology. *Technology*, 1:57–72, 2009.

[37] Toru Ishida. *Field Informatics: Kyoto University Field Informatics Research Group*. Springer Science & Business Media, 2012.

[38] Matt Jones, Gary Marsden, Norliza Mohd-Nasir, Kevin Boone, and George Buchanan. Improving web interaction on small displays. *Computer Networks*, 31(11):1129–1137, 1999.

[39] Gorgi Kakasevski, Martin Mihajlov, Sime Arsenovski, and Slavcho Chungurski. Evaluating usability in learning management system moodle. In *Information Technology Interfaces, 2008. ITI 2008. 30th International Conference on*, pages 613–618. IEEE, 2008.

[40] Yüksel Kavak and Gülsün A Baskan. Restructuring studies of teacher education in recent years in turkey. *Procedia-Social and Behavioral Sciences*, 1(1):364–367, 2009.

[41] Sang Hyun Kim, Clif Mims, and Kerry P Holmes. An introduction to current trends and benefits of mobile wireless technology use in higher education. *AACE journal*, 14(1):77–100, 2006.

[42] T Alfred Kisubi. Critique and analysis of universal primary education (upe) in uganda in general and suggestions for improvement in particular local areas. In *the Houston Texas Busoga Twegaite annual international convention, USA*, 2008.

[43] Agnes Kukulska-Hulme. *Mobile learning: A handbook for educators and trainers*. Psychology Press, 2005.

[44] Gulsun Kurubacak. Identifying research priorities and needs in mobile learning technologies for distance education: A delphi study. *International Journal of Teaching and Learning in Higher Education*, 19(3):216–227, 2007.

[45] José Paulo Leal and Ricardo Queirós. Integrating the lms in service oriented elearning systems. *Governance, Communication, and Innovation in a Knowledge Intensive Society*, page 180, 2013.

[46] A Lee. Systems thinking, design science, and paradigms: Heeding three lessons from the past to resolve three dilemmas in the present to direct a trajectory for future research in the information systems field,keynote address. In *Eleventh International Conference on Information Management, Taiwan*, 2000.

[47] Paul Legris, John Ingham, and Pierre Collerette. Why do people use information technology? a critical review of the technology acceptance model. *Information & management*, 40(3):191–204, 2003.

[48] Steven D Lonn. *Student use of a learning management system for group projects: A case study investigating interaction, collaboration, and knowledge construction.* PhD thesis, The University of Michigan, 2009.

[49] Edda Lwoga. Making learning and web 2.0 technologies work for higher learning institutions in africa. *Campus-Wide Information Systems*, 29(2):90–107, 2012.

[50] Jones M and Marsden D. Mobile interaction design. 10, 2006.

[51] Salvatore T March and Gerald F Smith. Design and natural science research on information technology. *Decision support systems*, 15(4):251–266, 1995.

[52] M Lynne Markus, Ann Majchrzak, and Les Gasser. A design theory for systems that support emergent knowledge processes. *MIS quarterly*, pages 179–212, 2002.

[53] Ludivine Martin, David Roldán Martínez, Olga Revilla, Maria J Aguilar, Olga C Santos, and Jesús G Boticario. Usability in e-learning platforms: heuristics comparison between moodle, sakai and dotlrn. In *Sixth International Conference on Community based environments. Guatemala*, pages 12–16, 2008.

[54] K Mayoka and Robert Kyeyune. An analysis of e-learning information system adoption in ugandan universities: Case of makerere university business school. *Information Technology Research Journal*, 2(1):1–7, 2012.

[55] Patricia McGee and Marybeth Green. Lifefelong learning and systems: A post-fordist analysis. 2008.

[56] Gary C Moore and Izak Benbasat. Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information systems research*, 2(3):192–222, 1991.

[57] Joel S Mtebe and Roope Raisamo. Investigating perceived barriers to the use of open educational resources in higher education in tanzania. *The International Review of Research in Open and Distributed Learning*, 15(2), 2014.

[58] Joel Samson Mtebe and Roope Raisamo. A model for assessing learning management system success in higher education in sub-saharan countries. *The Electronic Journal of Information Systems in Developing Countries*, 61, 2014.

[59] Ramzi Nasser. A formative assessment of information communication technology in lebanese schools. *International Journal of Education and Development using ICT*, 4(3), 2008.

[60] David Nichols and Michael Twidale. The usability of open source software. *First Monday*, 8(1), 2003.

[61] Karl Pajo and Catherine Wallace. Barriers to the uptake of web-based technology by university teachers. *International Journal of E-Learning & Distance Education*, 16(1):70–84, 2007.

[62] Ananthanarayanan Parasuraman. Technology readiness index (tri) a multiple-item scale to measure readiness to embrace new technologies. *Journal of service research*, 2(4):307–320, 2000.

[63] Keenan A Pituch and Yao-kuei Lee. The influence of system characteristics on e-learning use. *Computers & Education*, 47(2):222–244, 2006.

[64] Everett M Rogers. A prospective and retrospective look at the diffusion model. *Journal of Health Communication*, 9(S1):13–19, 2004.

[65] M Saeedikiya, A Mooghali, and B Setoodeh. Stages of the implemention of e-learning in traditional universities. *Edulearn10 Proceedings*, pages 6620–6624, 2010.

[66] Pauliina Seppälä and Harri Alamäki. Mobile learning in teacher training. *Journal of computer assisted learning*, 19(3):330–335, 2003.

[67] Alfred Sife, Edda Lwoga, Camilius Sanga, et al. New technologies for teaching and learning: Challenges for higher learning institutions in developing countries. *International Journal of Education and Development using ICT*, 3(2), 2007.

[68] Carolyn Snyder. *Paper prototyping: The fast and easy way to design and refine user interfaces*. Morgan Kaufmann, 2003.

[69] Grace Ssekakubo, Hussein Suleman, and Gary Marsden. Issues of adoption: have e-learning management systems fulfilled their potential in developing countries? In *SAICSIT Conf.*, pages 231–238, 2011.

[70] Grace Ssekakubo, Hussein Suleman, and Gary Marsden. Designing mobile lms interfaces: learners' expectations and experiences. *Interactive Technology and Smart Education*, 10(2):147–167, 2013.

[71] Grace Ssekakubo, Hussein Suleman, and Gary Marsden. A streamlined mobile user-interface for improved access to lms services. In *The Sixth International Conference on Mobile, Hybrid, and On-line Learning*, 2014.

[72] Ibrahim Turan. *Student readiness for technology-enhanced history education in Turkish high schools*. PhD thesis, University of Pittsburgh, 2007.

[73] Tim Unwin, Beate Kleessen, David Hollow, James B Williams, Leonard Mware Oloo, John Alwala, Inocente Mutimucuio, Feliciana Eduardo, and Xavier Muianga. Digital learning management systems in africa: myths and realities. *Open Learning*, 25(1):5–23, 2010.

[74] Monique Volman and Edith van Eck. Gender equity and information technology in education: The second decade. *Review of educational research*, 71(4):613–634, 2001.

[75] R Hevner von Alan, Salvatore T March, Jinsoo Park, and Sudha Ram. Design science in information systems research. *MIS quarterly*, 28(1):75–105, 2004.

[76] Ellen D Wagner. Enabling mobile learning. *EDUCAUSE review*, 40(3):41, 2005.

[77] William R Watson and Sunnie Lee Watson. What are learning management systems, what are they not, and what should they become? *TechTrends*, 51(2):29, 2007.

[78] Padraig Wims and Mark Lawler. Investing in icts in educational institutions in developing countries: An evaluation of their impact in kenya. *International Journal of Education and Development using Information and Communication Technology*, 3(1):5, 2007.

[79] T Winograd, J Bennet, L De Young, and B Hartfield. Bringing design to software addison-wesley. *Reading, MA*, 1996.

[80] Siu Keung Brian Wong, Thao Thi Nguyen, Elizabeth Chang, and Nimal Jayaratna. Usability metrics for e-learning. In *On The Move to Meaningful Internet Systems 2003: OTM 2003 Workshops*, pages 235–252. Springer, 2003.

[81] David Wood. Theory, training and technology: Part i. *Education+ Training*, 37(1):12–16, 1995.

[82] Gustavo Zurita and Miguel Nussbaum. A constructivist mobile learning environment supported by a wireless handheld network. *Journal of Computer Assisted Learning*, 20(4):235–243, 2004.

Appendices

A Questionnaire

MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY

INSTITUTE OF COMPUTER SCIENCE

Restructuring Learning Management Systems for Mobile Phone Use:
A case of Mbarara University of Science and Technology.

A research questionnaire to investigate the percentage of students who own mobile phones, LMS usage and reasons for not using the LMS as well as the most important service students would like to access on the LMS.

Dear respondent,

You are kindly requested to spare some time and fill in the questionnaire below. This is purely an academic research and any responses given will be treated with utmost confidentiality. So feel free to give the most appropriate answer by ticking in the box or filling in the space provided.

SECTION A: Demographic information

Personal Information / Background Information

1	Gender	a). Male ☐ b).Female ☐
2	Age	a) Between 18-25 years ☐ b) Between 25-35 years ☐ c) . 35 years and above ☐
3	Faculty	a). Faculty of Medicine. ☐ b). Faculty of Science ☐ c). Institute of Computer Science ☐ d). Institute of Management Science ☐ e). Institute of Interdisciplinary training and Research. ☐

1

4	Program	a). Bachelors Degree ☐ b). Masters ☐ c). PhD ☐ d). Diploma ☐ e). Certificate ☐
SECTION B: PHONE INFORMATION		
5	Do you have a phone and / Tablet	a). YES ☐ b). NO ☐ c). Tablet ☐
6	What type of phone do you have	a). Smart phone ☐ b). Ordinary phone ☐
7.	If the answer is a, (Smart phone) What type of smart phone?	a). Android based phone ☐ b). Windows based phone ☐ c). iPhone ☐
SECTION C: LEARNING MANAGEMENT SYSTEM		
8	Have heard of the MUST Learning management system?	a). YES ☐ b). NO ☐
9	If YES, have you used it before?	a). YES ☐ b. NO ☐
10	If NO, Why? (Skip to question 13)	a). I don't know how to access it ☐ b). I do not have a personal computer to access it ☐ c). I do not have a reason to access it. ☐

	If YES, proceed to question 11	Others Specify.....
11	How did you access the LMS	a). Using my Personal Computer ☐ b). Using computer in the computer Lab ☐ c). Using a friend's Computer ☐ d). Internet Café ☐ e). Using a mobile phone ☐
12	If the following devices for accessing the LMS were available to you, which one would you prefer to use? And why?	a). Mobile phone b). Computer/laptop, c). Others. Specify .... Why? ....
13	How many times have you logged into the LMS	a). Once ☐ b). 1-10 times ☐ c) Always ☐
14	If the LMS was accessible via your mobile phone, I would be motivated to use it.	a). Agree ☐ b). Strongly Agree ☐ c). Disagree ☐

15.	To what extent do you agree that the following LMS services are very important?	
	Service	Description
	1. Course outline	Used for summary outline, and/or course requirements **1. Strongly Agree 2. Agree 3. Undecided 4.Disagree 5. Strongly Disagree**
	2. Announcements	Used for informing students about the latest events around the university **1. Strongly Agree 2. Agree 3. Undecided 4.Disagree 5. Strongly Disagree**
	3. Downloads	Used for downloading lecture slides and notes plus all the important information as uploaded by instructors. **1. Strongly Agree 2. Agree 3. Undecided 4.Disagree 5. Strongly Disagree**
	4. Assignments	Students can attempt an online test, submit and get immediate feedback from after being evaluated. **1. Strongly Agree 2. Agree 3. Undecided 4.Disagree 5. Strongly Disagree**
	5. SMS alearts	Students and lecturers can be notified using SMS of any updates on the system For example, When notes have been uploaded or when a new assignment has been posted. **1. Strongly Agree 2. Agree 3. Undecided 4.Disagree 5. Strongly Disagree**
	6. Chating	Exchange messages online in real time with one or more simultaneous users of a computer network. **1. Strongly Agree 2. Agree 3. Undecided 4.Disagree 5. Strongly Disagree**

Thank you

4

B Research Ethics committee Approval

MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY
RESEARCH ETHICS COMMITTEE
P.O. Box 1410, Mbarara, Uganda. **Tel: +256 4854 33795, ,**
E-mail: sec.rec@must.ac.ug **Fax: +256 4854 20782**

Our Ref: MUREC 1/7 **Date:** February 26 2016

Mr. Dickson Kalungi
Postgraduate Student
MUST

Re: SUBMITTED PROTOCOL ON: "RESTRUCTURING LEARNING MANAGEMENT SYSTEMS FOR MOBILE DEVICE USE: A CASE OF MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY." NO. 02/01-16

Reference is made to the above protocol which was submitted to the Research Ethics Committee for review.

I am glad to inform you that your study has been approved for a period of one year up to February 02 2017.

The following documents have been approved with the application:

Document	Language	Version
Proposal	English	Version 2
Protocol form	English	Version 2
Data Collection tool	English	Version 2
Consent form	English	Version February 2016

You are required to register the study with Uganda National Council for Science and Technology, and submit progress and end of study reports to MUST REC.

You can now proceed with the rest of the research activities after getting permission from Uganda National Council for Science and Technology.

I wish you all the best.

Dr Francis Bajunirwe
CHAIR RESEARCH ETHICS COMMITTEE

C Screen Elements for Announcements

View publication stats